Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LXVIII. MAY, 1925 No. 5

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Contracts Awarded

ROADS AND STREETS

Ala., Birmingham—Independent Paving Co., Federal Asphalt Co., Dunn Constr. Co., Chamber of Commerce Bldg., awarded contracts by City Comn. to pave 12 streets, at $197,264.

Ala., Capitol Hts.—City let contracts at about $200,000 to pave 5 streets: Couch Constr. Co., concrete on Winona, Capitol and St. Charles Ave.; Hodgson & Jones, bitulithic and conc. on Yancey and James Ave.

Ala., Greenville—R. L. Kenan, Selma, awarded contract by State Hwy. Commn. (Montgomery), to grade, drain and surf. with sand clay 10 mile rd. from Greeenville to Wilcox Co. line, at $102,800.

Ala., Montgomery—State Hwy. Comn., Montgomeryq, let contracts for 4 roads and bridges; Covington Co. sand clay road, to J. M. Pilcher, Florala, Autauga Co., totaling 24 miles; Secs. A & B, Birmingham-Montgomery Hwy. to D. R. Cooke, Montgomery, at $115,992; Sec. C, northern end to Autauga Co. line to Newell Constr. Co., Birmingham, at $65,423; bridges on entire project to J. A. Pickford, Russell, Miss., at $68,497.

Ariz., Phoenix—Schmidt & Hitchcock, Phoenix, awarded contract by State Hwy. Dept., for constr. of 9 miles hwy. betw. Congress Jct. and Yarnell on Phoenix-Prescott Hwy., F. A. P. 72-B, at $177,-135.

Cal., Los Angeles—Southwest Paving Co., 806 Washington Bldg., awarded contract by County for impvt. of Anaheim-Telegraph Rd., Leffingwell Rd. and Central Ave.-Paint Ave., to Orange Co. line, at $123,000.

Cal., Los Angeles—Geo. H. Oswald, 366 E. 58th St., awarded contr. for impvt. of portion of Hawthorne Ave., at $55,000; Geo. R. Curtis Paving Co., 2440 E. 26th St., contract by Bd. Pub. Wks. for impvt. of Leeward Ave.-Wilton Pl. to Norton Ave., at $11,576; 41,483 sq. ft. Warrenite-bitu.; Chalmers & Ford, 533 H. W. Hellman Bldg. contr. by Board for impvt. of portion Nordhoff St., at $49,466; Robt. Metcalf, 637 W. 42nd Pl., contract by Board at $421,-174.36 for impvt. of Tracy St., at $421,174; 522,769 sq. ft. 5-in. conc. pave., 246,923 sq. ft. 1½-in. Warrenite surf. on 5-in. conc. base, etc.; B. D. Baucus, 5307 8th Ave., contract for conc. pave. curb, etc., at $7.712 in Newell St.; Griffith Co. contract at $21,640 for impvt. of 53rd St., Normandie, to Westtern Ave., 84,632 sq. ft. Warrenite-bitu., etc. Contractor located at 502 L. A. Ry. Bldg.

Cal., Santa Barbara—Southwest Paving Co., 806 Washington Bldg., Los Angeles, awarded contract for constr. Harris Sta.-Lompoc Rd., at $162,999.99; approx. 30,000 c. y. excav., 930,000 sq. ft. 1½-in. Topeka pave. on 3½-in. base (18-ft. pave.)

Cal., Signal Hill—Griffith Co., 502 L. A. Ry. Bldg., Los Angeles, awarded contract by city for impvt. of State St. and other thoroughfares, at $143,087.55; approx. 105,000 sq. yds. 4-in. asph. conc. pave. with 2-in. Willite wearing surf.

Fla., Bartow—Finley, Method & McCloud Companies, awarded contract by Polk. Co. Commrs., at $280,000 for 7 roads totaling 31 miles.

Fla., Clearwater—Nelson Bros., awarded contract by Pinellas Co. for 11 miles high type paving in Special Road Dist. No. 4, at $360,482.

Fla., Davenport—L. B. McLeod Constr. Co., Prospect Rd., Tampa, contract for about 10 miles asphalt and rock base paving, 100,000 lin. ft. curbs, gutters, storm sewer systems and 45,000 sq. yds. conc. walks, at $300,000.

Fla., Sarasota—W. J. Bryson Paving Co. and J. Y. Wilson, Jacksonville, awarded contract by Sarasota County to hard surf. 7 roads totaling 38 mi., Fla. line rock base, asphaltic surf. treatment, at $375,000.

Ill., Carbondale—Hamilton-Hoffman Constr. Co., Carbondale, awarded contract for Paving District No. 16, at $97,196.18.

Ill. Desplaines—Milburn Bros., Rockford, awarded contract for paving in what is known as Manor No. 2; estimated cost of work, $250,000.

Ill., Springfield—Jansen & Schaefer, 212 N. Cap St., Pekin, Ill., awarded contract for paving Rte. 9, Secs. 37, 38, 40, 41 and 41-D, Fulton and McDonough Cos., at $376,874.

Ill., Springfield—Following contracts let by Deways, April 1 to April 7: Pavement in Saline Co. on Sec. 32, to French Constr. Co., Fairfield, Ill., at $109,979; in Jo Daviess Co., Secs. 28 and 29, to Blackhawk Constr. Co., Waterloo, Iowa, at $276,-798; in Jo Daviess Co., Secs. 30 and 31, to Western States Paving Co., Davenport, at $49,959 and $56,907; Vermillion Co., Sec. 46, to Etchison-Patterson Constr. Co., Casey, at $109,784; Lake-Brown Cos., Sec. 20, to Universal Engrg. Co., Medford, partment Public Works and Bldgs., Div. of High-Wis., at $229,920; McMahan Constr. Co., Rochester, Ind., Sec. 10, Brown-Schuler Cos., at $58,730; Adams Co., Secs. 11, 12 and 13, to Hamilton-Hoffman Constr. Co., Carbondale, Ill., at $362,444; Franklin Co., Sec. 11X, to Mitchell Constr. Co., Marion, Ill., at $28,647; also Sec. 13V, at $7,240; R. G. Flaugher & Co., Urbana, Ill., contract for pavement in Clay-Richards Cos., Sec. 9, at $21,014, also grading in Jersey Co., on Secs. 2 and 2A, at $92,703, grading in Peoria-Knox Cos., on Secs. 47A and 48A, at $41,736; grading in Pike Co. on Secs. 14A and 15A, at $69,660, to Stevens Bros., St. Paul, Minn.; pavement in Iroquois Co. on Sec. 9, to Devine Constr. Co., Watseka, Ill., at $35,932.

Ind., Ft. Wayne—Moellering Constr. Co., Fort Wayne, awarded contracts by Allen Co. Rd. for Covington Rd. No. 1, Wayne Twp., 6,400 sq. yds. conc. at $20,325; and Upper Huntington Rd., Wayne Twp., 28,514 sq. yds. conc. at $77,450.

Ind., Michigan City—Seaman Constr. Co., Goshen, awarded contract for 28,000 sq. yds. conc. on portion of E. Michigan St., at $103,505.

Ky., Frankfort—The Beverly Wright Stuart Co., awarded contr. for work in Letcher Co.; county to pay one-half and Fed. Govt. the other half. Price is $157,301.69.

Mass., Boston—C. Bianci, Framingham, awarded contract by Dept. of Pub. Wks. here, for 14,595 ft. conc. paving on highway from Taunton to Berkley, at $154,630.

Mich., Lansing—Mich. State Trunk Line contracts let week ending March 28: No. 14-30 Gratiot Co., Arcadia, Emerson & Pine River Twps., Cl. F-7-in. Std. 20 ft. wide; 5.917 miles to Alex. Jeffrey, Saginaw, Mich., at $147,912 (est. cost cement, $52,017); 46-27, Gratiot Co., Wheeler Twp. Cl. F-7 in. Std. 18 ft. wide, 5.002 mi. to Thos. McNally, Saginaw, Mich., at $107,620 (cement $36,907); 22-10 B. Leelanau Co., Glenn Arbor Twp. Cl. A, 16 ft. wide, 2.442 miles to Leelanau Co. Rd. Comn., Leland, Mich., at $17,421; 24-32 B, Muskegon Co., Muskegon Twp., Cl. A, 18 ft. wide, 0.218 mi., to Thos. McNally, Saginaw, Mich., at $7,737; 43-13, Macomb Co., Warren Twp., moving bldgs., structs. Nos. 8 and 11, to Jacob Theut, Centerline, Mich., at $2,410; 53-13, Macomb Co., Warren Twp., moving bldgs., structs. Nos. 5, 20, 26, 9, 7 and 23, to Ann Arbor Asphalt Co., Ann Arbor, at $9,200; 53-13, Macomb Co., Warren Twp., moving bldgs., struct. No. 16, to Asa Wilcox, Caro, Mich., at $2,520; Fed. Aid contracts let same week: 90 B (Non T. L.), Tuscola Co., Wisner & Akron Twps. Cl. E-Bit. 20 ft. wide, 5.376 miles to John W. Ederer, Saginaw, Mich., at $141,815.89 (est. cost cement, $2,-923.80); 82 C (Non T. L.), Washtenaw Co., Ann Arbor Twp., Cl. G and DS, 1.327 mi., to Chris. Reger, Cloverdale, Mich., at $18,367.14 82 C (cement, $761.46.) County contracts let: Calhonu Co. Rd. Comn., 8.6 miles gravel to Wise Constr. Co., Watervliet, Mich., at $49,229; Linn Lake Rd., $7,-427.50; Clarendon-Butler Rd., $10,082; Hayes Disbrow, Hartford, Mich.; Genesee Co. Rd. Comn., to Andrew Langdon, Mt. Morris, 3 mi. top course gravel on Bray Rd., Thetford Twp., at $8,336.

Mo., Jefferson City—Following contracts let by State Dept. of Hwys.: Mercer Co., 2.190 mi. earthwork, No. 7296, 2.190 mi. 9-ft. conc. surf., at $17,-926; 4.606 mi. earthwork, 4.606 mi. 9-ft. conc. surf., $37,696; 3.780 mi. earthwork, $6,050; 3.780 mi. 9-ft. conc. surf., $30,738, to B. Layton, Kirksville; New Madrid Co.: C. J. Oglesby, Memphis, Tenn., 3.182 mi. earthwk., $13,373; 1.182 mi. 9-ft. conc. and 7-ft. conc. and 7-ft. gravel surf., $57,390; 3.056 mi. 9-ft. conc. and 7-ft. gravel surf., $50,472; 3.056 mi. earthwork, $10,110; Platte Co., to Albert Hood, Independence, Kas., 2.860 mi. 30-ft. graded earth, $14,549; 4.824 mi. 30-ft. graded earth, $41,459; Randolph Co.-Moberly to Cairo, to Lynch McDonald, Moberly, 4.985 mi. 9-ft. brk. surf., conc. base, $77,-091; 4.994 mi. earthwk., $17,783; 4.4994 mi. 9-ft. brk.

surf. conc. base, $69,537; 2.525 mi. earthwk., $11,906; 2.525 mi. 9-ft. brk. surf. conc. base, $35,324.

Neb., Falls City—Monarch Engineering Co., Omaha, awarded contr. for paving 28 blocks at $104,700.

Nev., Carson City—J. F. Murphy, 747 Lyon St., Los Angeles, awarded contract by Hwy. Dept., for constr. of State Hwy. in Humboldt Co., Winnemucca to Stonehouse, $162,041.

N. J., Highlands—Jannorone Constr. Co., 225 Passaic Ave., Belleville, awarded contract by Bd. of Freeholders, Monmouth Co. (Freehold), for conc. paving, 1.27 mi. Highlands-Stone Church Rd., at $88,036.

N. J., Irvington—(branch of Newark): Northern Constr. Co., 423 Amherst St., E. Orange, contr. for paving, at $10,869, Sheridan St. $11,446, University Pl. $22,495, Temple Pl. $5,385, Grove Terrace $12,390, Coolidge St.—Stuyvesant Ave. to Harding Terrace $21,005, Coolidge St. $4,800, Ellery Ave. $7,601, Cordier St. $17,924, Fleetwood Pl. $5,173, Beechwood Pl. $5,748, 37th St. $8,616, Wilson Ave. $5,612, Durant Pl. $15,871, Fairfield Pl. $2,894, Naden Ave. $15,430, Laventhal Ave. $16,860, Sager Pl. $4,822, Wolf Pl. $8,543; work involves 49,500 sq. yds. 6-in. rein. conc. J. Dorer, Irvington, contr. for Rodwell Ave., at $8,733, Quebec Ave., $11,119, 5,100 sq. yd. 6-in. rein. conc.

N. Y., New York—Following contracts let by Pres. Bronx Boro: Interboro. Asphalt Co., 2306 Creston Ave., bitum. conc. paving Jerome Ave., $23,926; sheet asphalt paving College Ave., $15,443; Gaffney Constr. Co., 50 E. 42nd St., sheet asphalt paving Mosholu Parkway, $87,983, to Asphalt Construction Co., 208 Broadway, Townsend Ave., $79,756; Leonard Paving Co., Woolworth Bldg., granite blk. paving Jerome Ave., $110,386 to J. Meehan & Son, 74 Cortlandt St., Boston Rd., $184,244.

N. Y., New York—Following contracts let by Pres. Bronx Boro.: Regan Towers Co., 124 W. 121st St., granite blk. paving to Kingsbridge Rd.—Fordham Rd. to E. 194th St., at $53,365; asphalt blk. repaving on Grant Ave. at $45,348 to Burnside Contg. Co., 270 Burnside Ave., asphalt block repaving on Southern Blvd., $63,085; Leonard Paving Co., Woolworth Bldg., granite blk. paving on Kingsbridge Rd.—Jerome to Sedgwick Aves.—at $112,473; St. George Granite Co., 90 W. St., East 138th St., at $90,824. C. D. Beckwith, 2875 Broadway, sheet asph. paving on Clifford Pl. at $9,898, Eastburn Ave., $17,746, to Gaffney Constr. Co., 50 E. 42nd St. Nelson Ave. at $33,750, to Interboro Asphalt Paving Co., 3306 Creston Ave., Shakespeare Ave., at $40,349.

N. Y., St. George—VanBro Constr. Co., 24 Elizabeth St., West New Brighton, awarded contract for grading and concrete paving on Hyland Blvd. Contr. 4, at $259,871.

N. C., Hendersonville—Carolina Contg. and Paving Co., Spartanburg, awarded contract for 66,000 sq. yds. conc. and asphalt paving, at $249,750.

Ohio, Idlewood—(Cleveland Heights, P. O.)—Following contracts let here: Cleveland Trinidad Paving Co., The Arcade, Cleveland, awarded contract for 49,500 sq. yds. sheet asphalt, 24,400 lin. ft. sand stone curb, 28,150 lin. ft. 4-in. drain tile gutter, 17,600 c. y. earth excav., at $254,590; Bentley Bros., 3030 Euclid Ave., Cleveland, contract for 14,700 sq. yds. sheet asphalt, 7,850 lin. ft. stone curb, 8,650 lin. ft. 4-inch drain tile gutter, 6,900 c. y. earth excav., at $83,540; grading, curbing and paving Meadowbrook Blvd., Fenwick 1, Traymore and Tyndall Roads, to Highway Constr. Co., 903 Lorain Co. Bank Bldg., Elyria, at $149,976.

Okla., Bartlesville—Hamilton Constr. Co. awarded contract to pave rd. from end of present pavement to Ramona, at $120,000.

Pa., Crafton—W. T. Clary, Crafton, awarded contract for repaving Crafton Ave. Engineer's est. $100,000.

Pa., Harrisburg—Road Constr. Co., Butler, awarded contract by State Hwy. Dept. for rein. conc. surf. Application 1041, Indiana Co., 21,749 sq. yds. conc., $3.25 per sq. yd., etc., at $102,542; Haydock & Martin, Franklin Trust Bldg., Phila., 9,500 sq. yds. rein. conc., 1,373 c. y. earth excav., and 1,819 c. y. earth excav., at $51,622.

R. I., Providence—New Haven Rd. Constr. Co., New Haven, Conn., contract by State Bd. of Public Roads, State House, for paving Contr. 2501, at $183,370; Contr. 2502 to A. D. Bridges, Hazardville, Conn., at $57,371; Contr. 2503, to T. E. Horne, Millbury, at $62,071.

Tenn., Nashville—Department of Highways and Public Works, Nashville, let contracts for 7 roads: Polk County, 12.56 miles grading and drainage on State Hwy. 39—Benton to Georgia State Line—to Corum Bros., Madisonville, Ky., at $69,515; Scott Co. 14.04 mi. grading and drainage, Mason Constr. Co., Elizabethtown, Ky., at $144,694; Gibson Co. 14.75 miles grading and drainage to Cresap Bros., Humboldt, at $83,480; also 7 bridges to Peterson & Earnhart, Montgomery, Ala., at $119,980; 9.41 miles cem. conc. pavement on State Hwy. 42—Madison Co. line to Milam, to Lawrence Constr. Co., Daniel Bldg., Jackson, Miss., at $227,644; Loudon Co. 5.23 miles cement conc. pavement to R. M. Galloway, Lenoir City, at $133,240; Sumner Co. .98 mi. rock asphalt on crushed stone base to Federal Contracting Co., Nashville, at $18,279; Hawkins Co., 10.02 miles grading, draing. and waterbound macadam surf. to Freeman Constr. Co., Knoxville, $144,689.

Tex., Cleburne—West Texas Construction Co., Cotton Exchange Bldg., Ft. Worth, awarded contract to pave Anglin and Caddo Streets with Warrenite Bitulithic on concrete base, at $161,662.

Tex., Galveston—H. J. Hetkes, Galveston, awarded contract at $123,668 to pave 31st and 39th Sts. from Broadway to Boulevard, 1-in. rock asphalt on 4-in. conc. base.

Wash., Seattle—Fiorito Bros., awarded contract by Board Pub. Wks. for impvt. of N. 46th St. et al. by paving at $176,797 (de Lavaud pipe).

W. Va., Charleston—State Rd. Comn. let contracts for 4 roads: Tucker Co. Proj. 3175A, to Keeley Constr. Co., Empire Bldg., Clarksburg, at $49,663; Jackson Co. grade 7.1 miles to Boso & Ritchie, Ravenswood, at $144,599; Calhoun Co. grade 1.46 mi. Hardaman & McGowan, Spencer, at $22,734; Calhoun Co. 7.5 miles grading to Cavin & Powers, Charleston, at $101,509.

Wis., Janesville—Matthes Coal & Constr. Co., 1810 W. First St., Davenport, Iowa, awarded contract for approx. 30,700 c. y. excav., 103,580 sq. yds. reinf. conc., at 17,300 lin. ft. comb. curb and gutter, 910 lin. ft. spcl. gutter flg., 200 sq. yds. walk, etc., etc., at $224,193.

Wis., Kenosha—J. R. Griffith, Racine, Wis., awarded contract by Kenosha Co. Hwy. Comn., for excavation, surf. culvts., bridges, etc., on Silver Lake-Twin Lakes rd., at $134,978.

Wis., Shawano—Perry Fess, 123 E. Doty, Madison, awarded contr. by Wis. Hwy. Comn., (Madison) for surf., culverts, curb, gutters, etc., on Shawano-Bonduel Rd. Proj. 345A, at $105,658.

SEWERAGE AND SEWAGE TREATMENT

Ala., Birmingham—Will Love awarded contract for completion of san. sewer, at $123,622.

Cal., Corona—R. F. Ware, 2146 E. 36th St., Los Angeles, contract for disposal plant, including Imhoff tanks, filters, etc., at $110,922.

Cal., Los Angeles—J. C. Hickey, 320 Palm St., Alhambra, Cal., awarded contract by City, at $61,184 for constr. of Sec. 8, Glendale intercepting sewerage system. Low bidders, previously awarded contract, failed to sign in required time. Martin Brkich Co., 309 Douglas Bldg., awarded contract for constr. of Sec. 24, North Outfall sewer betw. intersect. of Enterprise St. with Santa Fe and 23rd St. with Trinity St. on type 1 (brick-concrete), as follows: 5,226 ft. 5-ft. semi-elliptical brick-concrete sewer compl., at $80,000; (b) 8,441 ft. 5-ft. 6-in. semi-elliptical brick-conc. sewer compl., at $130,500.

Cal., Los Angeles—Joe Chutuk, 343 Wilcox Bldg., awarded contract by Bd. of Public Works, at $138,118 for cement sewer in Central Ave.—Florence to Manchester Aves.; Geo. W. Kemper, P. O. Box 126, Alhambra, awarded contract, at $65,500 for sewers in Calzona St.—Whittier Blvd. to Mines Ave.

Cal., Los Angeles—T. Kelly & Sons, Hill Street Bldg., awarded contract for work in Draing. Impvt. Dist. No. 11, by Supvrs. Los Angeles Co. Draing. Dist. 11, at $1,473,994.

Cal., Los Angeles—J. M. Derenia, 237 W. 83rd St., awarded contract for storm drain in Santa Monica Blvd.—Las Palmas to Sycamore Aves., at $20,000. Contr. let by Bd. of Pub. Works. Following let by County for sewer work: W. H. Robinson, 403 Lankershim Bldg., contract for Co. Impvt. 317, at $2,500.52 for sewer in Moneta Ave.; also

contr. for sewer in 100th St. Impvt. No. 315, at $2.230.08; M. Miller, 208 W. 2nd St. for sewer in Compton Ave., at $43,544; Jno. S. Mitchell, 3225 York Ave., contract for sewer in Hammel St., at $2,098; W. H. Robinson, contract for Impvt. 291, at $7,218.54.

Cal., San Fernando—Marko Matich, 1436 W. 51st St., Los Angeles, awarded contract at $39,180 (using conc. pipe) for constr. of main outfall sewer and complete Imhoff tank and sprinkling filter sewage disp. work.

Ont., Toronto—Nelson River Constr. Co., Bank of Hamilton Bldg., awarded contract by York Twp. for 8,000 ft. 36-in. concrete outfall sewer, at $83,-300.

B. C., Vancouver—City will lay 6.04 miles sewer at Ceddar Cottage on 20th to 34th Aves. by day labor, at cost of $147,000. E. D. Todd, Municipal Hall, Engr.

D. C., Washington—Warren F. Brenizer Co., 101 N. Y. Ave., N. E., awarded contract at $70,000 for constr. of 13 sewers; W. F. Cush Co., Inc., 3rd and R Sts., contract at $8,000 for 3 sewers; W. A. Pate, Jr., Rockville, Md., contract for 1 sewer.

Fla., Largo—J. B. Crary Constr. Co., Atlanta, Ga., awarded contract for sewers in various streets, at $300,000.

Ill., Lombard—G. F. Santry Co., Mallers Bldg., Chicago, awarded contract for 8-15-inch san. sewers in Greenfield Ave. and vicinity and Park-side Dist., at $37,955.

Ill., East St. Louis—Keeley Bros. Contracting Co., East St. Louis, awarded contract for the Market Ave. Sewer Dist., at $88,864.

Ia., Correctionville—E. L. Royer Constr. Co., Des Moines, awarded contract for 23,000 ft. 8-12-in. sewers in various streets, 75 manholes, Imhoff tank, etc., at $35,500.

Md., Baltimore—Adams & Marino Co., 216 St. Paul St., awarded contract by Board of Awards, City Hall, for 11,500 ft. main and lateral sewers in San. Dist. G-13, Contr. 219, at $86,653.

Mich., Detroit—Detroit Drainage Constr. Co., 5099 Lemay Ave., vit. crock sewer in Lat. 4297, at $3.700; Lat. 4300, at $5,365; Lat. 4303, $19,995 and Lat. 4308, at $12,597.

Okla., Pittsburg—Sherman Iron Works, 18 E. Main St., Okla. City, awarded contract for 18,200 ft. 6-12-in. vit. clay sewers in all streets, septic tanks, etc., at $26,120.

Ore., Monmouth—Elk & Lind, Portland, awarded contract for installation of municipal sewage disposal system for City; $48,609.38 for vit. pipe and installation; $10,689 for disposal tank.

Orio, Portsmouth—S. E. Frowine, 1664 Highland Ave., awarded contract for separate san. and storm sewers, at $61,264.

R. I., Providence—F. A. Gammino, 331 Broadway, awarded contract by Board of Public Works for sewerage works in Smith Street, at $47,724.

S. D., Madison—McHose Sand and Tile Co., First National Bank Bldg., Boone, Iowa, awarded contract for sewage disposal plant, at $47,649.

Tex., Galveston—W. A. Kelso & Co., 2220 C St., awarded contr. for constr. of drains on 31st and 39th Sts., at $42,742.

Tex., Houston—A. E. Quay Constr. Co., 4717 Jack Street, awarded contract for storm sewer in W. Gray Ave., at $16,225; West Dallas Ave. to C. H. Horton, 2202 Clay St., at $33,138.

Tex., Magnolia Park—Sherman-Youman Constr. Co., 529 West Bldg., Houston, awarded contract for storm and sanitary sewers in various streets, at $307,220 and $46,793, respectively.

Va., Roanoke—Tinsley Constr. Co., Roanoke, awarded contract by City for 9 sanitary sewer projects; J. R. Vaughan, 1100 Maiden Lane, Virginia Heights, Roanoke, sewer on Melrose Ave.; cost of entire project, $275,232.

Wis., Milwaukee—Wenzel & Hench Co., 498 27th St., awarded contract for 7,310 ft. 36-in. concrete and 2,620 ft. 24-in. terra cotta sewers, etc., in First Ave. extension, at $296,570.

Wis., Milwaukee—G. E. Zimmerman, 3402 Grand Ave., awarded contr. for 4,363 ft. 30-in. conc. and 5,144 ft. 18-24-in. terra cotta sewer, etc., in Sec. 2, Lincoln Ave., at $215,626.

Wis., Phillips—Eklund Constr. Co., 14 N. 58th Ave., West Duluth, Minn., awarded contract for 15,000 ft. 8-in. vit. sewer tile, 11,200 ft. 10-15-in. sewers in various streets, disposal plant, etc., at $37,885.

WATER SUPPLY AND PURIFICATION

Ariz., Flagstaff—Cook & O'Brien, Kansas City, Mo., awarded contract by City for constr. of 79,000 ft. flow-line for new reservoir and water works, using concrete pipe furnished by Bent Conc. Pipe Co. Contract price, $144,400.

Calif., Corona—Sidney Smith, 2025 Bay St., Los Angeles, contr. by Dan Kilkey, Parkridge Country Club, Corona, for hoseless water system involving 9 miles 1½-in. to 8-in. pipe, one 100,000-gal. swimming pool and comb. reservoir, at $39,500.

Cal., Vallejo—Western Pipe & Steel Co., 444 Market St., San Francisco, awarded contract for elec. welded steel pipe, 58,640 ft. 24-in., 3/16-in. thick, 20,660 ft. 24-in., ¼-in. thick, and 35,620 ft. 24-in., ¼-in. thick and 35,620 ft. 22-in., 3/16-in. thick, for Gordon Valley Municipal Water Proj., at $344,000.

Ill., Shelbyville—Merkel Contg. Co., 100 Davidson Bldg., Kanas City, Mo., awarded contract by City for 100,000-gal. tank on tower, one 700 g.p.m. and 500 g.p.m. motor-driven centrif. pump, found. for pumping equipt., 4,200 ft. elec. transmission line, etc., at $120,000, which includes purchase of private plant and also $6,690 cash refund to City, leaving net price, $113,400 for plant and new work.

Md., Baltimore—Southern Supply Co., 315 N. Calvert St., awarded contract by Bd. of Awards for galv. w. i. pipe, couplings and malleable iron fittings, at $12,195; cast iron pipe and fittings to R. D. Wood & Co., 400 Chestnut St., Phila., at $284,024.

Mass., Bridgewater—B. Nicoll & Co., Inc., 294 Madison Ave., New York City, awarded contract by Board of Water Commrs., for about 10 miles 6-14-inch mains in various streets, at $78,686.

Mo., Kansas City—U. S. Cast Iron Pipe Co., awarded contract by Fire & Water Board here, for furnishing cast iron pipe, at $171,066.75; DeLaval Steam Turbine Co., contract for centrifugal pumps, at $72,000.

Mo., Kansas City—Following contracts let late in March by Kansas City: Missouri Valley Tunnel to Smith Bros., Dallas, at $1,319,750; Turkey Creek Tunnel to Smith Bros., Inc., at $825,575; East Bottoms pumping station and reservoir to Carrothers Construction Co., Kansas City, at $683,220; East Bottoms flowline, Biggs Constr. Co., Akron, Ohio, at $524,205; motors, switchbds., outdoor substa., to Westinghouse Electric & Mfg. Co., at $149,-750; settling basins to James Black Masonry & Contracting Co., St. Louis, at $1,663,540; filtration plant, chemical house and secondary pumping station to Chanute Constr. Co., at $1,260,749; river intake and low-lift pumping station to List & Weatherly, Kansas City, at $222,350; valves to Kennedy Valve Co., at $99,418. The 11 contracts amount to $6,748,557. Contracts to complete the system are yet to be awarded. Total expenditure involved is $9,500,000.

Minn., Winona—Following contracts let for municipal water works system: Contr. B: Pumping station to Sontag & Murtinger, Winona, at $36,197; Contr. C. Rein. conc. reservoir to A. Larson & Co., 418½ S. Barstow, Eau Claire, Wis., at $54,800; Contr. D: Cast iron pipe and fittings to U. S. Cast Iron Pipe Co., 122 S. Michigan Ave., Chicago, Ill., at $3,632; Contr. E: Valves and Sluice gates to Ludlow Valve Mfg. Co., 209 S. LaSalle St., Chicago, Ill., at $2,039; Contr. E: Air compressors and air-lift pumping plant to R. B. Whitacre, 205 Roberts St., St. Paul, Minn., at $26,755.

N. Y., St. George—Wataga Contg. Co., 308 Lenox Ave., New York City, awarded contract for mains in Clinton, Forrest and Westervelt Aves., etc., here, at $112,900.

N. Car., Apex—Following contracts let by Town Commrs. for water and sewers: Tucker & Laxton, Realty Bldg., Charlotte, for filter plant, exterior piping, erecting pumps, filter equipt., bldg. dam, water pipe laying, sewer pipe laying; Carolina Willys Light Co., Laurinburg, for transmission line; Morris Machine Works, Charlotte, for pumping equipt.; Chicago Bridge & Iron Works, 1045 Healey Bldg., Atlanta, Ga., for wash water tank and tank and tower; Grinnell Co. No. Charlotte, for valves, hydrants, furnishing cast iron pipe and specials for distribution system and pumping mains; Pomona Terra Cotta Co., Pomona, for furnshing sewer pipe.

N. C., Charlotte—Allis-Chalmers Mfg. Co., Milwaukee, awarded contr. for water wheels; General Electric Co., Schenectady, N. Y., contract for generators, switches and other equipment for hydro-electric plant at Rocky Creek, Lancaster County, to be constructed by Southern Power Co., Charlotte, W. S. Lee, Vice President. New unit will be twelfth in chain of plants built by this company and will call for investment of $1,250,000; 60,000 horse power.

N. C., Greensboro—Paul N. Howard, King Bldg., Grensboro, awarded contract by City for water and sewer lines, at $148,092.

Ohio, Cincinnati—U. S. Cast Iron Pipe & Fdry. Co., Addyston, awarded contract for 750 ft. 36-in. cast iron pipe for Eden Park Reservoir, at $10,334; J. Dempsey, 2314 Kenton St., contract for Contr. No. 1, $20,570 and $24,173, respect.; 7,838 ft. 6 and 8-inch cast iron mains, Water Supply Line 9, Dist. No. 1 to W. Hennigan, 7011 Montgomery Rd., Norwood, at $15,937.

Ohio, Coitsville—(Youngstown) Lloyd Contg. Co., Xenia, awarded contr. for new water lines in Coitsville Twp. here, at $127,926.

Ohio, Piqua—Director of Public Service, H. A. Lines, let contract to Green & Sawyer, Lima, for water works bldgs., at $154,996; carbonation equipment, $5,900, heating and plumbing, $8,740, lighting and power, $10,390, bridges, $17,400; Shartle Mach. Co., 369 Dublin Ave., Columbus, contract for pumps, at $17,236; Pittsburgh- Des Moines Co., Curry Bldg., Pittsburgh, standpipe, $27,880.

Okla., Tonkawa—Werland Constr. Co., Okla. City, awarded contr. for water works system, at $75,000.

Pa., Philadelphia—Following contracts let by Department Public Works, Bureau of Water: M. & J. B. McHugh, 892 No. Markoe St., Contr. No. 743, at $34,205; P. & A. J. Ellis, 5724 N. Markoe St., Contract No. 744, Item 1, at $37,890; Items 2 and 3 to Chapman Valve Mfg. Co., 1011 Filbert St., at $10,395.

Tex., Galveston—Davis-Pace Co., 1306½ Young St., Dallas, awarded contract for rein. conc. reservoir, at $108,950.

Wash., Spokane—General Machinery Co. awarded contract for supplying main and auxiliary pumps for new upriver pumping station, at $3,400; 4 horizontal pumps; $1,141.30 for 2 vacuum pumps; Westinghouse Elec. & Mfg. Co. contract for furnishing motors, sw. bds., etc., at $35,000.

Prospective Work

ROADS AND STREETS

Ariz., Fed. Road Projects—Surveys of various roads to be constructed by Bureau of Public Roads, —E. S. Wheeler, Dist. Engr.—has started. Ralph C. Jones assigned to supervise survey work. Approx. $1,056,000 allotted to Arizona. About $1,185,000 to New Mexico and surveys for this work will also be supervised by the Phoenix office.

Ala., Birmingham—Plans have ben worked out, and are ready for submission to State Hwy. Commission, whereby 75 miles main hwys. in Jefferson Co. may be paved with permanent materials. Est. cost $4,000,000. It is planned to join force of State, County Commissions for labor and materials. Bessemer to Bibbs, City limits of Birmingham to St. Clair Co. line near Leeds, and other roads included.

Ala., Birmingham—City plans to expend $400,000 to pave 7 streets and avenues, including 18th, 19th, 35th Sts., and 5th Ave. A. J. Hawkins, City Engr.

Ala., Florence—City plans to pave Royal Ave. and lay sewers. $264,000 bonds voted.

Ala., Vernon—Lamar County plans 3 roads: Guin to Sulligent, Sulligent to Fayette County, through Vernon; probably road from Vernon to Pickens Co. line; $300,000 appropriated.

Ark., Batesville—City plans to expend $250,000 to pave 75 blks. in various sections.

Fla., Arcadia—City plans paving, extending lights, sewerage and water mains. Considering $350,000 bond issue. J. B. McCrary Co., Engrs., Atlanta, Ga.

Fla., Bushnell—Sumter Co. Commrs. plans 60 miles of road paving. Cons. Engrs., E. V. Camp & Associates, Moreland and DeKalb Aves., Atlanta. F. L. Rulland, Chrmn. Comn.

Fla., Clearwater—Pinellas County, Safety Harbor Road & Bridge Dist., plans improving and bldg. 5 roads. $425,000 bonds voted.

Fla., Dade City—Pasco County Commrs. plan to build 27 roads totalling 125 miles. $1,333,000 bonds voted.

Fla., Ft. Pierce—City plans expendt. of $3,000,000 during 1925 on streets and paving, storm and san. sewerage system; construction of water works plant on site of 20 acres; municipal dock; viaduct at Citrus Ave.; parks on Indian River; constr. of promenade along Moore's Crk.; dredge creek; bui d retaining wall; more all public utilities to site of water works.

Fla., Jacksonville—Duval Co. Commrs. plan to complete road bldg. Election May 26th to vote on $1,125,000 bonds.

Fla., Key West—Monroe Co. Commrs. plan 4 roads and seawall. Voted $2,650,000 bonds; complete Key West to Key Largo road, $2,000,000; ocean front blvd. and seawall around Key West, $500,000; Tamiami Trail, $100,000; Cape Sable rd., $50,000.

Fla., Orlando—Orange Co. plans to widen several roads and build new highways to outlying portions of County. Considering $2,500,000 bond issue.

Fla., St. Petersburg—City plans to expend $2,100,000 for about 50 miles brick and asphalt street paving. Will sell bonds. Ernest Kitchen, Director of Pub. Works.

Fla., Sebring—City plans extending boulevards and paving annexed subdivisions and those to be annexed. Votes this summer on bonds.

Fla., Tallahassee—State Rd. Dept., Tallahassee, will soon receive bids to rebuild 1 mile betw. Whitfield Estates and Sarasota Co. line. Department plans to expend $8,000,000 for impvts., including Tamiami Trail betw. Sarasota and Punta Gorda and Brooksville and Inverness.

Fla., Tavares—Lake County, Groveland and Wascotte and Okahumpka Districts, plan to build 2 roads, totaling 37 miles perm. hard surf. $750,000 bonds voted. Geo. F. Revels, Co. Commr.

Fla., Zephyrhills—Town plans about 5 miles paving. Est. cost $396,709; contemplates $131,903 bond issue.

Ill., Harvey—More than $1,000,000 will be expended here for impvt. and paving of streets. Work on $301,800 worth of paving is now pending in court and includes paving of Main St. to connect up no. end job on Park Ave. to 154th St.; also Center Ave. impvt., and paving of all streets west of Morgan.

Ill., Petersburg—Plans now being prepared by Holbrook, Warren & Van Praag, Cons. Engrs., 416 Millikin Bldg., Decatur, Ill., for pavements within City joining present city pavements with paved highways now constructed, or under construction. Est. cost approx. $80,000.

Ky., Beattyville—State Hwy. Comn., Frankfort, will soon receive bids to build rd. in Lee Co.—Point near Beattyville to pt. at so. end of St. Helena's bridge. Est. cost $125,000.

Ky., Frankfort—State Hwy. Commission has decided to advertise for maint. reconstr. work on state proj. 21½ in Campbell Co.—Alexandria to Pendleton Co. line. Est. cost $60,000. Commission has accepted Fulton, Morgan, Boyle and Letcher Co. resolutions presenting funds for road work. Morgan Co. resolution presenting $50,000; Fulton Co. funds totaling $115,500 for work on state proj. 54-C —Hickman to Ky.-Tenn. line near Reelfoot Lake. Letcher Co. offered $86,515.93 for work on Whitesburg-Harlan rd.

Ky., Olive Hill—Council voted Ord. for paving all main streets of City which will be done as soon as water works and sewerage system is installed, which it is expected will be completed by Sept. of this year. City will spend approx. $300,000 in impvts. this year.

Mich., Lansing—State Highway Commr. Rogers at meeting of State Administrative Board, recommended that State Hwy. Dept. be authorized to carry on completion of pavements in vil'ages of State through which trunk lines pass. He stated there were approx. 30 villages where such paving was desirable. Matter referred to Road Committee.

Mich., Pontiac—City will pave two sections of Paddock and small section of Jessie Streets with

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Kentucky Rock Asphalt Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Pierce-Arrow Motor Car Co.

Automobiles.
Ford Motor Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Brick, Paving.
National Paving Brick Mfrs. Assn.

Bridges.
Luten, Daniel B.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping
Littleford Brothers.
Pawling & Harnischfeger

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Gun Work.
Indiana Gunite & Const. Co.

Cement Testing.
Chicago Paving Laboratory.
Flood & Co., Walter H.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Van Trump, Isaac.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chemists, Engineering
Chicago Paving Laboratory.
Dow & Smith.
Flood & Co., Walter H.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Van Trump, Isaac.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Clay Pipe, Vitrified.
Clay Products Assn.

Clay Products.
Clay Products Assn.

Concrete Bridges.
Luten, Daniel B.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Rosing, Inc., Astrid S.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Consulting Engineers.
Alvord, Burdick & Howson.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Druar & Milinowski.
Flood, Walter H., & Co.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

brick. Est. cost of brk. paving on No. Paddock—East Pike to Perry—$95,000; S. Paddock St.—Mich. Air Line tracks to Jessie, and Jessie St.—Paddock to Saginaw—$75,870.

Minn., Minneapolis—Resolutions passed by City Council to pave 38th St.—Dupont to Chicago Aves. Asphalt, conc., abt. $110,000. Henry N. Knott, City Clk.

Mo., Cape Girardeau—City contemplates paving Sprigg St.—North to Washington and from City limits to Pearl St. Est. cost $100,000.

N. C., Greensboro—City plans to resurf. streets and grade and relay sidewalks, curbs, gutters, etc. Contemplates $1,000,000 bonds. E. G. Sherrill, City Clk.

N. C., Plymouth—Town plans street impvts. Considering $300,000 bond issue. Address Town Clerk for detailed information.

N. C., Statesville—Board of Commrs., Iredell County, has authorized sale of $1,000,000 bonds for road and bridge constr. H. L. Gilbert, Chrmn.

N. C., Wilson—Wilson County voted $1,250,000 bonds for rd. and bridge constr. H. B. Lane, Chmn. Board of Commrs.

Okla., Lawton—Comanche Co. Commrs. plan 5 hard surf. roads: East to Stephens Co. line; so. to Cotton Co. line; southwest to Tillman Co. line; no. to Caddo Co. line. $400,000 bonds voted. F. P. Aycock, Co. Clerk.

Okla., Tulsa—City Commrs. will soon receive bids for paving in 17 districts. Est. cost $250,000. City Engr. Chas. Schultz.

Tenn., Memphis—City plans various impvts. $900,000; viaduct impvts. $350,000. Rowlett Paine, Mayor.

Texas, Lagrange—Fayette Co. plans hwy. to connect Winchester with proposed Lagrange-Giddings Hwy. J. P. Kirby, Co. Engr. Anderson: Grimes Co. plans 8.8 mi. 16-ft. gravel rd. on Hwy. 45—Roans Prairie to Walker Co. line; approx. cost $121,500. Oscar A. Seward, Jr. Co. Engr., Navasota; Ralph W. Barry, Co. Judge. Anson: Jones Co. plans hard surf. rd. on Hwy. No. 1—Anson to Co. line. Approx. cost $457,000; Devlin Engrg. Co. Engr.; Owen Thomas, Co. Judge; Decatur: Wise Co. plans 100 miles rd. bldg. Considering $1,000,000 bond issue.

Tex., Jacksboro—Chf. Engr., U. S. Bureau of Public Rds., Washington, D. C., approved plans for 17.38 miles 18-ft. asphalt macadam road on State Hwy. 39, Jacksboro Co. from Lynn Creek to Archer Co. line. Approx. cost $309,000. Guy R. Johnston, Co. Engr. H. C. McClure, Co. Judge.

Tex., Waco—City plans opening up of 7th St.—Washington to Austin. $150,000 bonds voted. V. G. Koch, City Engr.

Va., Covington—Alleghany County Board of Supvrs. contemplate bldg. Clifton-Forge-Covington Hwy. State allocated $500,000.

Va., Norfolk—Walter E. Taylor, 3rd, Director of Public Wks. plans to expend. $284,000 additional for paving, draing. sewerage and other impvts. in annexed territory.

Va., Princess Anne—Will soon vote here on $250,000 bonds for 3 roads, including bridge, in Kempsville Dist.; 7 miles Water Works rd. to Lynnhaven Inlet with brdg. over Lynnhaven inlet; 9 miles from Indian River rd. through Kempsville to Va. Beach Blvd. at Euclid; 1.8 miles rd. at Glen Rock.

Wash., Seattle—Contract for 3.3 miles paving in West Seattle will be let within next 30 days. Est. cost $152,000. Forty-fourth, 45th and 46th Aves. southwest will be paved from W. Lander to Mass. Sts. and cross streets will be hard surfaced.

Wash., Tacoma—City Council has ordered Ord. for improvt. of Front St. Entire impvt. estimated at $414,056 by City Engr. J. C. Manley.

W. Va., Charleston—City plans street impvt.; considering $165,000 bond issue; straighten and improve Bigley Ave. to connect with State road, $25,000 to open Wash St., at old State grounds, pave and lay walks, $25,000; open and extend Columbia Blvd., $15,000; widen Summers St., $100,000.

W. Va., Clarksburg—Harrison County, Grant District, plans to grade and improve 4 sections of conc. surf. roads; contemplates $352,000 bonds; 26,268 ft. Clarksburg-Weston pike from Freeport to McWhorter. Est. cost $174,553; 10,500 ft. bitum. macadam from W. Milford to Lost Creek, $92,606; 9,300 ft. bitum. macadam from Lost Creek to Rockford; 9,300 ft. conc. from W. Milford or First Forks Duck Creek rd., $41,490. Clair N. Parrish, Clk.

W. Va., Pineville—Wyoming Co. plans completion of 3 roads: 11 miles Welch-Pineville; Baylesville to Pineville; Rockview. $178,000 bonds voted.

W. Va., Summersville—Nicholas County plans hard surfacing all State roads. $1,000,000 bond election planned.

SEWERAGE AND SEWAGE TREATMENT

Ala., Montgomery—City will construct storm and sanitary sewer. Est. cost $150,000.

Ark., Lepanto—Prelim. plans being prepared here for san. sewerage system; also disposal plant. Est. cost betw. $60,000 and $80,000. T. H. Allen, 1430 Bank of Commerce & Trust Bldg., Memphis, Tenn., Cons. Engrs.

Cal., Alhambra—Election June 2nd to vote on $135,000 bond issue for sewer construction. Asst. City Engr. Otto Rugen.

Cal., Beverly Hills—City trustees have adopted resolution of intention to call bond election to vote on $160,000 issue for sewer outfall.

Cal., Dunsmuir—$200,000 election planned here for sewerage system. C. C. Kennedy, Call Bldg., San Francisco, Engr.

Cal., Los Angeles—Cities of Covina, San Dimas, Puente, Baldwin, Charter Oak, West Covina, Azusa and other dists. east of San Gabriel river have petitioned Co. Supvr. to join metropolitan sewer project. Cost of this dist. sewer system would amount to probably $5,000,000.

Cal., Los Angeles—West Hollywood District has authorized $240,000 bond issue in connection with County Sanitation District plan. This district, which includes Sherman, is known as Dist No. 4. Dist. No. 3 includes Long Beach and Signal Hill districts. Will vote in June on a $3,540,000 issue.

Cal., Venice—City trustees have adopted ord. authorizing issuance of $325,000 outfall sewer bonds. T. H. Hanna, City Clk.

Cal., Ventura—City has under way plans for sewer extensions. Est. cost about $125,000. C. W. Pierce, City Engr.

Ont., Toronto—East York Twp. Sammon Ave. Municipal Yard, plans 6,000 ft. conc. and vit. clay san. sewers, 12 in. up in Poullon Ave. $9.889 and Gowan Ave. $26,400. G. R. Jacko, Twp. Engr.; also York Twp. making plans for 9,000 ft. 21-33 in. san. and storm sewers in Oakwood Ave. to Arlington Ave. $36,000. James, Proctor & Redfern, 36 Toronto St., Toronto, Engrs.

Conn., Waterbury—Town plans to issue bonds in sum of $100,000 for storm water drainage; also $650,000 bonds for sewerage system expansion.

Ill., Barrington—Public hearing held for new storm sewerage system which it is planned to install here this year. Est. cost of system, together with necessary legal engrg., and special assessment expenses is $348,203.33.

Ill., Downers Grove—Final hearing on new Sanitary District for Downers Grove held and it is expected that final order will be entered at once for at least 4 additional sewer projects est. to cost $500,000.

Ill., Joliet—Plans for three large trunk mains and intercepting sewers for all streets in west side territory recently annexed to City, being made by City Engr. Calkins. Est. cost of impvt. $500,000. Will require about a year to complete as much of the excavation is through rock.

Ill., Herrin—Prelim. plans being made for disposal plant and sanitary sewers in various sections of City. Est. cost $300,000. G. H. Anderson, City Hall, Engr.

Ill., Lake Forest—Preliminary plans being made by North Shore San. Dist.—J. Oliver, Pres.—for disp. plant, including Imhoff tank, sludge beds, chlorinating tank and grit chamber. Est. cost $35,000. Pearse, Greeley & Hansen, 6 No. Michigan Ave., Chicago, Engrs.

Ill., Venice—Preliminary plans being made here for sanitary sewerage system, pumping plant, etc. Est. cost approx. $200,000 up. Shepard & Morgan, Cons. Engrs., Edwardsville.

Ill., Waukegan—North Shore San. Dist. preparing prelim. plans for sewage disposal plant. Includes Imhoff tanks, sludge beds, chlorinating tank and outfall sewer. Est. cost $75,000. Cons. Engrs. Pearse, Greeley & Hansen, 6 N. Michigan Ave.,

BUYERS' GUIDE

Deep Well Pumps.
Harris Air Pump Co.
Keystone Driller Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.
Rosing, Inc., Astrid S.

Dryers.
Cummer & Son, The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Machinery.
Westinghouse Electric & Mfg. Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Excavating Machinery.
Austin Machinery Corp.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co., Inc.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Fire Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Gates, Sluice.
Coldwell-Wilcox Co.

Graders.
Austin-Western Road Machinery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gunite.
Indiana Gunite & Const. Co.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
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Joint Fillers (Paving).
The Barrett Co.
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The Texas Company.

Kettles (Portable).
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Manhole Covers.
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Mastic.
The Barrett Co.
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Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
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Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corp.
Koehring Co.
T. L. Smith Co.

Motor Fire Apparatus.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
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Motor Trucks.
Duplex Truck Co.
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International Motor Co.
Kissel Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
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Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Murpysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
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Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
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W. W. Strickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
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The Texas Co.

Pipe Manufacturers.
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Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

Chicago. J. Oliver, Pres. of Dist. Highland Park, Ill.

Mass., Arlington—Board of Selectmen plans to extend sewers in various streets. $60,000 appropriated; new storm drains, $20,000 appropriated. Engineer not yet selected.

Mass., Medford—(Boston, P. O.)—Town preparing to improve and extend sewerage and water systems at cost of abt. $80,000. C. Connock, City Engr.

Mass., Needham—Bd. of Sewer Commrs. plan to extend lines in main streets and connect with Metropolitan sewerage system. $150,000 appropriated. Engineer not yet selected.

Mo., St. Louis—Prelim. plans being made for segmental block or brick and vitr. clay sewers in Baden Sewer Dist 4. $167,000-$173,000. W. W. Horner, 300 City Hall, Engr.

N. D., Fargo—Two prelim. plans made for sewerage system for district formerly in Village of No. Fargo. R. H. Slocum of N. D. A. C., Engrg. Dept., made plans. One plan would care for drain of 640 acres, including only college and No. Fargo dist. Est. cost, $65,000. The other plan would provide trunk sewer outlet for Beardsley's and Tyler's Addns., 1,058 acres. Est. cost $175,000. Will probably take action before July. $10,000 appropriation made for college's share of expense. City Engr., R. T. Jacobson; St. Commr., Geo. Hoenck.

Ohio, Elyria—G. B. Gascoigne, 1149 Leader-News Bldg., Cleveland, Cons. Engrs., and preparing plans for sewer lines and sewage treatment plant to be built here. Est. cost $600,000.

Ohio, Garfield Hts.—(Cleveland, P. O.)—City plans sewers in Sewer Districts Nos. 3 and 4. Est. cost $100,000. R. F. Munz, Town Hall, Engr.

Tenn., Knoxville—City will probably extend sewerage system to Lonsdale at cost of $75,000. Louis Brownlow, Manager.

Tex., Austin—City (W. D. Yett, Mayor) contemplates voting on $100,000 sewer bonds.

Tex., Dallas—City—Harry Gowins—Water Commission, has approved plans for constr. of sewage pumping station, $70,000; also So. Dallas san. sewer mains, $160,000.

Tex., San Antonio—City plans to extend 4,500 ft. 72-in. and 84-in. rein. conc. sewers through City sewer farm to outfall sewer main, including 410 ft. siphon. $125,000 appropriated. I. Ewig, City Engr.

Tex., Wichita Falls—City considering constr. of sewage disposal plant here. Est. cost $175,000. May vote on bonds. For detailed information address Mayor.

Va., Portsmouth—City Council authorized expenditure of $180,000 for sewers; $30,000 for incinerator.

W. Va., Charleston—City considering extension of sewerage system in Swann Hill, etc. May vote on $285,000 bonds.

WATER SUPPLY AND PURIFICATION

Ala., Girard—Alabama Water Co. (F. C. Basenberg, Chf. Engr.) will expend $76,000 on impvts. to water plant.

Ala., Tuscaloosa—Morris Knowles, Pittsburgh, and Geo. G. Earl, New Orleans, Cons. Engrs., have recommended that City continue to secure water from Warrior River. City Commission expected to order the carrying out of program of impvts. at water plant, and main extensions, for which $250,000 bonds were recently voted. C. E. Abbott, Supt.

Arig., Mesa—City has under consideration expenditure of $73,000 on present water system in accord. with recommendations of Weiland Engrg. & Construction Co., of Denver.

Cal., Alhambra—Election June 2nd to vote on $150,000 water extension bond issue.

Cal., San Diego—The $400,000 bond money transfer to general fund for new water mains carried at recent election.

Ont., Arnprior—Surveys being made for hydro-electric plant here. Est. cost $5,000,000.

Que., Carillon—Power development here, preparing plans for hydro-electric development on St. Lawrence River. $50,000,000.

Ont., St. Catherines—New water works system projected here at expendt. of $400,000, that will include new filtration plant. Construction will probably start this Summer.

Ont., Welland—Prelim. plans being prepared for constr. of water works filtration plant, including electric pumps, for Welland. Impvts. will cost about $300,000.

Colo., Loveland—Ord. prepared here for issuance of $300,000 bonds for making extensive impvts. and extens. to water works system of City.

Fla., Sebring—City will soon vote on $2,500,000 bonds for water, electric lights, white-way system, parks, etc., etc.

Fla., Punta Gorda—City will install 207,000 gal. capy. reservoir.

Fla., W. Palm Beach—West Palm Beach Water Co. (R. E. Dougherty, Supt.) will expend. $500,000 on impvts. and extensions to water works system.

N. Y., Dexter—$90,000 bonds voted here for water supply system, including well, pumps and tank. H. T. Field, Flower Bldg., Watertown, Cons. Engr.

Minn., Duluth—Ord. passed appropriating $109,850 for purch. of cast iron pipe for Water & Light Dept. P. G. Phillips, Commr.

Mo., Sedalia—Public Service Commission, Jefferson City, has approved issue by Sedalia Water Co. $900,000.

Ohio, Fairview—Villages of Rocky River and Fairview, Ohio, considering linking up their water works systems. Rocky River plans $150,000 water and sewerage impvts. this year.

Okla., Okmulgee—Election in near future to vote on one million dollar bond issue for water works, which includes dam or reservoir. City Commr. W. E. Carpenter.

Ore., Portland—Barr & Cunningham, Cons. Engrs., Spalding Bldg., are engineers for sanitary sewerage system, on which bids will be called for. Est. cost $65,000; also storm sewer, $40,000. This firm also engineers for water works system at Sutherlin to be built at cost of $45,000. Sewer sys. above mentioned will be constructed in Forest Grove, Ore.

S. D., Aberdeen—Election in near future to vote on $200,000 bond issue for water works system. Lydia Kohlhoff, City Aud.

Tenn., Knoxville—City (Louis Brownlow, Mgr.) appointed Alvord, Burdick & Howson, Chicago, Ill., as Cons. Engrs. for water works here. $2,500,000 available.

Tex., Corpus Christi—City (J. T. Wright, Secy.) plans to expend $100,000 in impvts. to water works.

Tex., Fredericksburg—Prelim. plans being made for water works, mains, pumping equipt., etc. Bond issue in sum of $120,000 will be voted on. Cons. Engrs. Terrell-Bartlett, Engrs., 612 Calcasieu Bldg., San Antonio.

Texas, Greenville—City will receive bids in May for water works impvts. Est. cost $400,000. Henderson Rush, Box 561, Engr.

Va., Ft. Mitchell—Robert L. Crigler, Ft. Mitchell, elected Pres. of Dixie Hwy. Company, organization incorporated with $100,000 capital stock for purpose of securing water supply for residents of Dixie Hwy. betw. Covington and Erlanger. Project will cost about $175,000 and involves main constr. and installation of booster pump. Covington will extend its city mains at cost of $24,000 and Dixie Hwy. Co. will continue the lines.

Wash., Auburn—$200,000 bond issue authorized here for installation of new water works system that will involve spring water supply from source 4 mi. distant, and capable of a 20,000,000 gal. per day delivery.

BUYERS' GUIDE

Pumps.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.

Rock Asphalt.
Kentucky Rock Asphalt Co.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Scarifiers.
Austin-Western Road Machinery Co., The

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The

Scrapers, Power.
Sauerman Bros.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Clay Products Assn.
Dee Clay Mfg. Co., W. E.
Rosing, Inc., Astrid S.

Sewer Pipe Joint Compound.
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Dallmann Machine & Mfg. Co.
Good Roads Machinery Co., Inc.

Special Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin-Western Road Machinery Co., The

Steam Shovels.
Keystone Driller Co.

Steel Joists, Studs and Sash.
Truscon Steel Co.

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Lighting.
Holophane Glass Co.
Westinghouse Electric & Mfg. Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch.
The Barrett Co.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Best Tractor Co., C. L.
Ford Motor Co.
Holt Mfg. Co., Inc.

Transmission, Truck.
Warford Corp.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Turbines, Steam.
De Laval Steam Turbine Co.

Turntables, Truck.
The Hug Co.

Valves.
Coldwell-Wilcox Co.

Vitrified Clay Pipe.
Clay Products Assn.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.
Stewart, W. H.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barrett Co., The
Carey Co., Philip.
Pioneer Asphalt Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
Coldwell-Wilcox Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Murphysboro Paving Brick Co.

Wood Block (Creosoted).
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—**Contraction Joint**
—**Cranes, Locomotive**
—**Crushers, Stone**
—**Drag Scrapers**
—**Dragline Cableway Excavator**
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—**Excavator, Crane**
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—**Gasoline Locomotives**
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—**Heaters, Asphalt**
—**Heaters, Tar**
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—**Road Plows**
—**Road Rollers**
—**Road Scrapers**
—**Sand Dryers**
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—**Scarifiers**
—**Scrapers, Power**
—**Sheet Piling, Steel**
—**Skimmer, Scoop**
—**Steam Shovels**
—**Stone Elevators**
—**Stone Screens**
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—**Tampers, Road**
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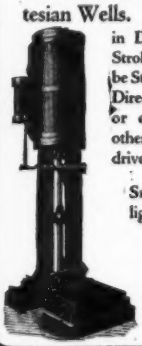

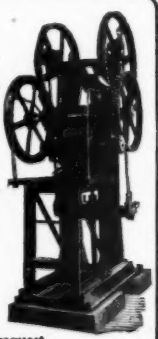

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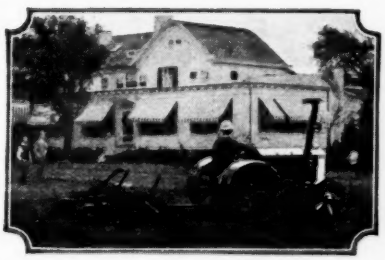

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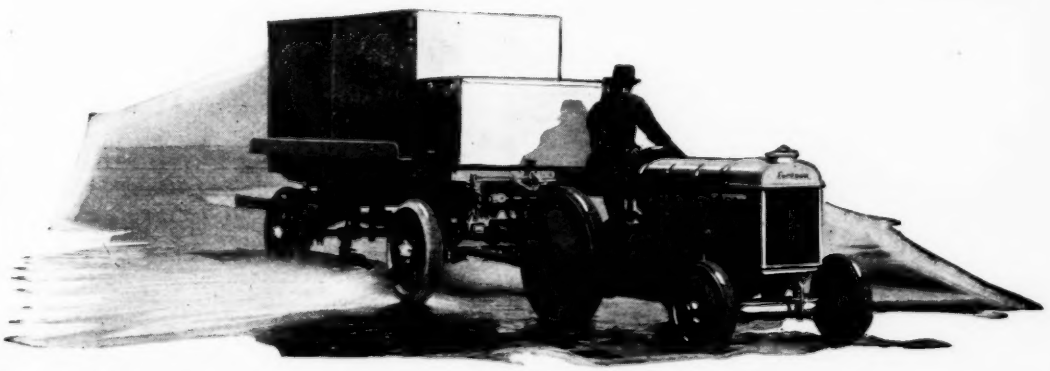

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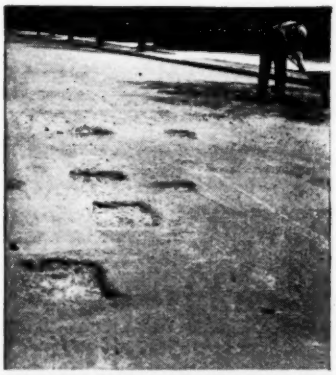

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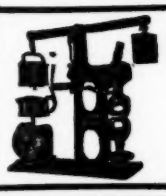

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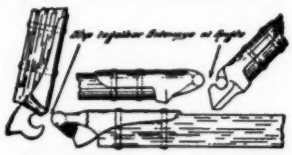

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MIDDLE COST METHOD OF DETERMINING VALUE

By Willis D. P. Warren, of Holbrook Warren & Van Praag, Consulting Engineers, Decatur, Ill.

General

The purpose of this paper is to review cast-iron pipe prices, to discuss various valuation methods heretofore used, and in particular, to present a new method for determining "present fair value." The valuation method herein proposed differs somewhat from the "original cost," the "reproduction cost," the "prospective competitor," and other methods of valuation in that it is based on "normal" or "middle prices," rather than on "original" or "current prices;" and in the further fact that such "middle prices" bear a distinct relationship to "wholesale prices" of all commodities.

It is proposed to show that the "fair value" of cast-iron pipe varies as the wholesale prices of all commodities, and that accordingly, the "present fair value" of this important item in water works property is governed by the wholesale prices of all commodities, rather than by its original cost, or by its market price as of the date of the appraisal. It is also desired to demonstrate that neither peak prices, nor the lowest prices of cast-iron pipe represent "fair value," but that there is a "middle price" as of any given date which does indicate "present fair value" as to that date. Accordingly it is proposed to present herein, what is termed a "Middle Cost Method" of valuation.

Primarily it is intended to discuss "fair value" of water works property for rate-fixing purposes, however, it is held that this value should in general be the same as the value for either sale or purchase. In the matter of "depreciation," deduction should be made only for actual tangible depreciation, and in order to be consistent, such deduction should be made whether value is computed by the "Middle Cost Method," the "Original Cost," the "Reproduction Cost," or by whatever method. "Going value," or "development expense," and "over-head," are all items which enter into any valuation; however, it is desired to confine this paper to a discussion of the important item of cast-iron pipe, and a method of determining its "present fair value," rather than to a discussion of these other several elements.

Considering somewhat broadly the subject of valuation, it is interesting to note that few large appraisals were made prior to 1900, and that there was practically no literature on the subject previous to that date. Also it is observed from a study of this important subject that many early valuations and court decisions were made in a period when it was hardly possible to have had the same comprehensive and helpful data which is now available, on which estimates of "fair value" may be based. This is quite readily understood when we investigate the record of cast-iron pipe prices over a period of the past 66 years. This full 66-year period, just now completed, with its history of great price fluctuations, affords a most unusual and valuable background for the study of "fair value."

Present Valuation Theories

In presenting a new theory as to the proper method of determining "present fair value," it will be of interest to test it in the light of important Supreme Court decisions. As an indication of the present methods of determining "present fair value," it may be stated that the United States Supreme Court has repeatedly ruled against "original cost" as a proper base for rate-making, and in a number of important recent decisions has adopted "current reproduction costs" as a measure of value. These recent decisions were no doubt influenced in a measure by the then "current" prices, and by the argument that "rates of tomorrow cannot ignore prices of today."

A brief review of various important decisions is also of peculiar interest, in that such decisions practically all emphasize the desire of the courts for a more definite and rational measure of "present fair value." Following are references to a number of these decisions:

"The basis of all calculations as to the reasonableness of rates to be charged by a corporation maintaining a public utility under legislative sanction must be the fair value of the property being used by it for the convenience of the public, and in order to ascertain that value, the original cost of construction, the amount expended in permanent improvements, the present cost of construction, the probable earning capacity of the property under the particular rates prescribed by statute, and the sum required to meet operating expenses, are all matters for consideration and are to be given such weight as may be just and right in each case." Smyth v. Ames, supra; San

Diego Land and Town Co. v. National City, supra; Stanislaus County v. San Joaquin and King's River Canal and Irrigation Co. supra; Chicago Union Traction Co. v. City of Chicago, supra; Duluth Street Railway Co. v. Railroad Com. supra."

See also Southwestern Bell Telephone Co case of Missouri, decided May 31, 1923:

"It is impossible to ascertain what will amount to a fair return upon properties devoted to public service without giving consideration to the cost of labor, supplies, etc., at the time the investigation is made. An honest and intelligent forecast of probable future values made upon a view of all the relevant circumstances, is essential. If the highly important element of present costs is wholly disregarded such a forecast becomes impossible. *Estimates* for *tomorrow* cannot ignore *prices* of *today*."

Also decision of United States District Court for District of Indiana, decree of Court confirming Master's Report dated March 8, 1923, as follows: "The basis of appraisement, namely upon values as of July 1, 1922, appears to be the only just and fair measure of the value of the property at the time of the inquiry. It is the business carried on in the year 1922 that is here in question; and not only are the expenses measured by the price levels of the year, but so also is the fair return. For the same reason the rate base itself should be measured in terms of the price levels of the year 1922. It is universally conceded that temporary or 'peak' price levels should not be used. There is no evidence that the price levels of 1922 are temporary and there is evidence that there will probably be little change for a number of years. If in the future there shall be a lowering of price levels, so that the valuation of the rate base is no longer in harmony with them, there will of course be a revaluation of the property to conform to the new price levels." "The Master, therefore, adopts the valuation on the basis of prices of July 1, 1922."

In the Springfield Gas Case, 291 Ill. 209, the Supreme Court of Illinois definitely adopted the rule thus fixed and subsequently followed in the federal decisions, "that present value must be the basis of all calculations as to the reasonableness of rates."

The decisions above referred to are very significant in that they emphasize the degree to which the courts insist that "present fair value" be made the basis for rate fixing; and yet with all deference to the high tribunal which adheres to the theory "that present value is best reflected by present costs of production," and "that estimates for tomorrow cannot ignore prices of today," we desire to inquire whether or not "prices of today" are "values of today?" It is proposed to discuss and answer this

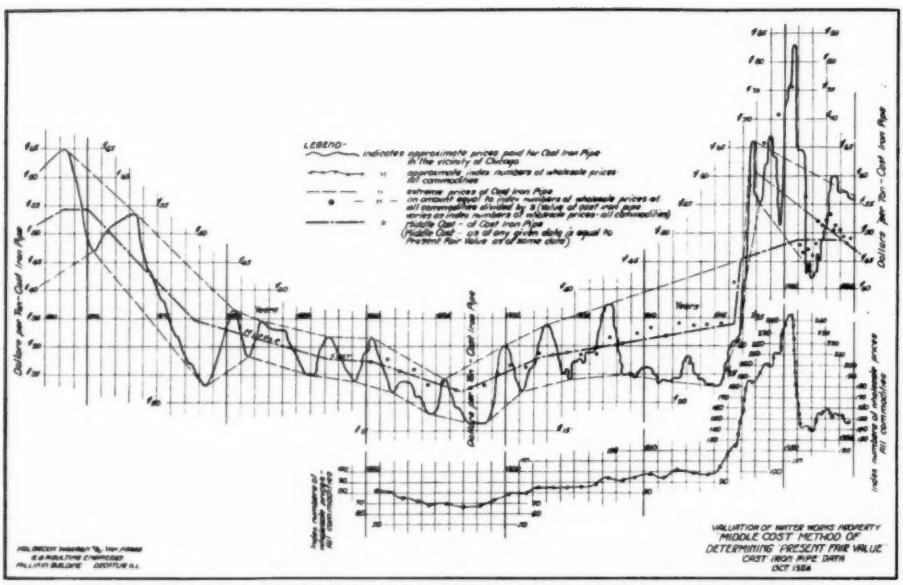


CHART TO ILLUSTRATE MIDDLE COST METHOD OF VALUATION.

question under the head of "Middle Cost Method."

Middle Cost Method

In order to understand more fully the "Middle Cost Method" of valuation, as indicated by the attached chart, it may be stated that the curve representing cast-iron pipe prices from 1858 to 1924 is approximate, although in general the prices shown are those in the vicinity of Chicago. The light broken line connecting peaks and a similar line connecting depressions indicate extreme, or abnormal values which might be assigned to cast-iron pipe as of any given time. In drawing a heavy broken line longitudinally, practically midway between the peaks and depressions, we may safely state that this "average," "normal," or "middle" line at any given date, will more nearly represent "value," than the "current price" as shown for the same date.

From 1890 to about 1910 it is observed that the "normal" or "average price" of cast-iron pipe was an amount equal to approximately one-third (1/3) of the value assigned to the index numbers of wholesale "prices" of all commodities, as compiled and published by the United States Bureau of Labor Statistics. While there is a definite relationship between the two, the figure given above (1/3), need not necessarily be constant at all times and under all conditions.

In any consideration of cast-iron pipe "values," it should be recognized that World War "prices" were "abnormal," and that "values" were greatly inflated at that time. With this thought in mind it is estimated that "fair values" during the war period were really not above the line of extended "peak prices" as of the period of 1899 to 1907. In the light of past price fluctuations it appears rational to assume also that cast-iron pipe "prices" would cease to rise when "wholesale prices" of all commodities began to decline, as occurred in 1920. Also that with "average prices" of cast-iron pipe declining, and with "wholesale prices" of all commodities declining, the "fair value" of cast-iron pipe will decline, as now appears to be the case.

In support of the Middle Cost Method it should be borne in mind that the United States Supreme Court has repeatedly held that "present fair value" is not measured by "original cost," and that it is not measured by "current costs of reproduction," arbitrarily applied; but on the other hand, the Supreme Court has definitely stated in the recent Southwestern Bell Telephone Company Case, decided May 31, 1923, "that the utility is entitled to a fair return upon the reasonable value of the property at the time it is being used for the public, and that due allowance must be made for increases in value since the original cost was incurred," thus practically fixing "present fair value" as the "normal value," at the time the investigation is made.

The "normal value" as of a given date may be defined as being the "market value" as of that date, assuming business conditions to be normal, and wholesale prices of all commodities normal, and not under the influence of undue optimism or pessimism as to the future. In considering this method of valuation as applied to cast-iron pipe, it is interesting to analyze the results for certain particular dates, and also for certain periods.

In a period of *declining* "values," as shown by the accompanying curves, it is apparent that the *utility* will be properly safeguarded by adopting a "middle cost method" of valuation; and at the same time it is equally apparent that the *public* will benefit by such a method, rather than by adopting averages for preceding years, or by adopting "current" prices, which are as liable to be high as they are to be low.

In a period of *rising* "values," the *utility* would most seriously object to average prices of preceding years, and also to current prices if low; and so, too, would the *public* seriously object to current prices if high. It therefore follows that the "normal" price, that is, the "middle" price, as of the date of the investigation is the fair and reasonable one to apply in ascertaining the "present fair value." And as a positive check on the accuracy of the "middle cost method" of ascertaining "present fair value," we may compare the result obtained by this method, with the index numbers of wholesale prices of all commodities. For a period of many years, and particularly during normal times, the "normal" or fair average price of cast-iron pipe was an amount equal to practically one-third (1/3) of the index numbers of wholesale prices of all commodities. This fixed relationship between cast-iron pipe "values" and average wholesale prices of all commodities has been maintained for so many years that we may safely consider the average wholesale prices of all commodities as a safe guide and check

in determining "present fair value" of cast-iron pipe, although this particular relationship need not necessarily hold true under all conditions.

It is greatly to the interest both of the utility and of the public to avoid frequent fluctuations or changes in rates, therefore such rates should be based on "middle costs," rather than on "prices" as of the date of the appraisal. From the above discussion it is quite apparent that the "middle cost method" of valuation is applicable to the ascertainment of "fair values" in items other than cast-iron pipe, and also in properties other than water works.

Inconsistent Valuation Methods

In considering any new method for the ascertainment of "present fair value," it is well to bear in mind that there is a wide divergence of opinion as to the fairness of present valuation methods, even among members of the Supreme Court of the United States, and for this reason it should be of general interest to discuss and endeavor to develop a more rational and consistent method of valuation. In this connection reference is made to the extended criticism of the decision of the United States Supreme Court in the Southwestern Bell Telephone Case of Missouri by Justice Brandeis, concurred in by Justice Holmes.

As an example of the inconsistency of the "original cost method," depreciation often is deducted, or not deducted, in order to justify original cost, depending upon the necessities of the case at the time of the investigation. Apparently, actual tangible depreciation is a matter of small concern to the advocate of the original cost theory, when by ignoring it they will secure a value which satisfies the peculiar interests of their client, and on the other hand, under different conditions, by allowing it, they likewise satisfy the peculiar interests of another client. With a full knowledge of price fluctuations over the past two-thirds of a century, the inconsistency of the original cost, as well as the prudent investment theories should be readily apparent both to the public and to the utility. The accompanying curves demonstrate quite clearly the inconsistency of the original cost method.

The cost of reproduction method of valuation has been generally followed by valuation engineers, and by the courts, although, as stated by one court, only for the reason that it appears to be less *inconsistent* than other valuation methods. This inconsistency is worthy of thought when we consider the wide range of "values" which may be determined under various applications and interpretations of the cost of reproduction method. For example, will *current* prices be adopted in computing the cost of reproduction; will *average* prices of the preceding *two years* or *five years*, or will *average* prices of the preceding *ten years* be adopted as indicating fair values as of the date of the investigation? Manifestly, from a study of *all past "price' fluctuations*, "current" price is not a measure of "fair value," for if so, utility rates would be subject to change almost every year. Analysis shows that average prices over a period of two or three years, are as liable to work a severe hardship on the public as on the utility, for averages over such a period may indicate only extremely low or extremely high "prices" of that period, rather than "normal values."

Equally inconsistent, is the practice of using average prices over a period of five or ten years preceding the date of the appraisal, for as a matter of fact, such averages tend to indicate *"past* fair values," rather than *"present* fair values." This important and simple truth is borne out by the history of price fluctuations, which, as shown here, covers a period of two-thirds of a century. That "past fair values," rather than "present fair values" are indicated by such averages, is better understood when we study and analyze the accompanying price curves, showing the long periods of declining values, and the long periods of rising values.

A clear recognition of this fact, that *"values" gradually rise and fall over comparatively long-time periods*, will definitely show the fallacy of undertaking to ascertain "present fair value," by the use of *averages* which *indicate* only *"past fair value."* In the final analysis therefore, the cost of reproduction method of valuation can be only a "judgment valuation," depending rather upon the judgment and opinion of the appraiser as to use of "present" prices or "average" prices over various periods of years, than upon sound valuation principles developed through a full knowledge of the past history of the rise and fall of values.

Conclusion

In concluding this discussion of the interesting and important subject of val-

uation, it is desired to point out that while particular emphasis has been placed on a certain method of determining "present fair value," there are many other elements which should also receive consideration before ultimate conclusions can safely be formed as to "fair value." While such other elements are important, it is not the purpose of this article to consider them at length, but merely to point out that the ascertainment of "present fair value" is a process which calls not only for the application of well-founded valuation principles, but also, as stated by one court, "for the exercise of sound judgment and common sense."

In the valuation of water works property, the important item of cast-iron pipe justifies careful study and investigation, and yet at the same time, probably no more than other items, the "value" of which can be determined only by similar study and analysis. Application of the Middle Cost Method of Valuation may properly be made not only in determining "values" in the appraisal of water works properties, but also in the appraisal of other utility properties, whether for purposes of rate-fixing, or for the purposes of sale or purchase.

In summarizing important principles of valuation which should be kept clearly in mind, when undertaking the ascertainment of "present fair value" of cast-iron pipe, it is desired to emphasize the following:

1. The history of *cast-iron pipe* discloses wide fluctuations in "price," with gradual changes in "value." These gradual changes in "value" of cast-iron pipe take place over comparatively long-time periods.

2. The history of wholesale prices of *all commodities* indicates that fluctuations in "price" are far greater than fluctuations in "value." The gradual changes in "value" of all commodities take place over comparatively long-time periods.

3. The "value" of *cast-iron pipe* bears a distinctive relationship to the "value" of *all commodities*, and varies directly as the "value" of such commodities. In other words, the index numbers of wholesale prices of all commodities is a safe guide as to the "present fair value" of cast-iron pipe.

4. "Present fair value" must be the basis of all calculations as to the reasonableness of rates.

5. The "original cost" method of valuation is inconsistent, in that it assumes a "value" for cast-iron pipe which may in reality be far removed from the "value" of all other commodities, as of the date of the investigation, and consequently, far removed from "present fair value" of cast-iron pipe.

6. The "cost of reproduction" method of valuation is a "judgment valuation," and is inconsistent in that it generally either assumes "current" prices or "average" prices of past years. In the first case the value ascertained as of the date of the appraisal will tend to be inconsistent with "normal" values and with the values of all other commodities; and in the second case, the value ascertained will represent "past fair value" rather than "present fair value."

7. In a period of *declining* values, it is unjust to the *public* to use "average prices" of preceding years in undertaking to determine "fair value."

8. In a period of rising values, it is unjust to the *utility* to use "average prices" of preceding years in undertaking to determine "fair value."

9. Neither "low prices," nor "peak prices," as of the date of the investigation represent "present fair value" as of that date.

10. The "Middle Cost Method" of valuation assumes "normal values" as of the date of the investigation, and is entirely rational and consistent in that such normal values of cast-iron pipe conform to the normal values of all other commodities as of the same date, thus assuring a "fair value" as of the date of the investigation.

The Middle Cost Method of Valuation conforms to the requirements of the leading Supreme Court decisions in that it considers past, present, and probable future prices; for as a matter of fact, it determines "present fair value" by projecting a *normal value* line, either *ascending* or *descending* through various price fluctuations, arriving finally at "*present fair value*," as of the date of the appraisal. Careful study will demonstate that "present fair value," as thus determined, is entirely consistent and rational.

11. In order to be consistent, "present fair value" of cast-iron pipe must conform to the combined values of all other commodities, and since by the Middle Cost of Valuation this is found to be the case, it is safe to conclude that "present fair value" as thus determined

is a reasonable and proper basis for rate fixing.

12. "Future value" is a matter of mere speculation, and may, or may not, be closely related to "past value." "Present fair value" is the nearest possible approach to "future value."

13. The "value" of cast-iron pipe for rate-fixing purposes, is fair and reasonable when its exchange power in relation to other commodities is "normal." "*Value is a ratio in exchange.*"

14. "Present fair value," as determined by the Middle Cost Method of Valuation, is a proper basis for rate-fixing, in that it is reasonable, and entirely consistent with the value of other commodities.

In final conclusion, it is desired to emphasize the importance of a full knowledge of price fluctuations over long-time periods, in undertaking to determine "present fair value." Such knowledge by the public, and by the utility owners, will tend to create a far better understanding of the difficult problem of rate-fixing.

COURT DECISION PROTECTS WATER SUPPLY AGAINST MINE DRAINAGE

By Almon L. Fales, of Metcalf & Eddy, Consulting Engineers, 1¼ Beacon St., Boston, Mass.

(Editor's Note: The following article gives the final status of the suit to enjoin the Melcroft Coal Co., et al., from polluting the supply of the Mountain Water Supply Co., in Pennsylvania. The case is a famous one and has attracted national attention. The article is the text of the report of the committee on Industrial Wastes in Relation to Water Supply of the American Water Works Association Council on Standardization, as presented at the 1925 meeting of the Association.)

During the past year, members of your Committee on Industrial Wastes in Relation to Water Supply have followed developments along the lines of the committee work and have submitted to the chairman the information thus obtained. This information, together with that already published in the Progress Reports of the Committee, will be summarized as Topic 13, in the forthcoming Manual.

The outstanding development in the field of Industrial Wastes in Relation to Water Supply is the decision of the Supreme Court of Pennsylvania in the so-called Indian Creek Coal Mine Drainage Pollution Cases. In the Progress Report of the Committee, published in May, 1923, the subject of Pollution of Water Supplies by Acid Wastes from Coal Mining Operations was discussed and the case of Mountain Water Supply Co. vs. Melcroft Coal Co., was outlined up to that time. In view of the importance of this case, it has seemed advisable at this time to summarize the proceedings including the final status of the case.

The Case

In 1920, the Mountain Water Supply Company, the Pennsylvania Railroad Company, and others filed bills in equity in the Fayette, County, Pa., court to restrain the Melcroft Coal Company and some twenty other coal companies and individuals from polluting Indian Creek with drainage from various mines on the watershed. Later the Commonwealth of Pennsylvania, through the attorney-general, was allowed to intervene as a plaintiff because of the public nature of the case.

After various legal preliminaries, the case came to trial during the summer of 1922. Both sides were ably represented by an array of legal talent and engineering experts.

Indian creek, having a watershed of about 130 sq. miles, was virtually unpolluted in 1906 when the plaintiffs constructed an impounding reservoir a few miles above the mouth of the stream to supply water to Pennsylvania Railroad locomotives and to the public. The piping system was gradually extended until at the time of the trial some 75,000 people were receiving a portion or all of their supply from the Indian creek reservoir, in addition to the large volumes of water used for locomotives and other industrial purposes by the railroad.

It was admitted by the defendants that drainage discharged into the stream from mines on the watershed, opened subsequent to construction of the dam, caused pollution of the stream, and that this pollution would increase with further development of mining operations.

Discharge of coal mine drainage has destroyed for domestic use numerous streams in Pennsylvania and has so altered the character of many others as to make treatment of the water difficult and expensive. In recent years this pollution has occurred without check in view of a decision of the Supreme Court

of the state in the so-called Sanderson cases, which held that such discharge was permissible even though it rendered the water unfit for domestic purposes, and caused other damage to lower riparian owners. This Indian creek case was, therefore, in effect an attempt to reverse the decision in the Sanderson cases and naturally assumed much importance not only in Pennsylvania, but also in other states where the discharge of mine drainage causes trouble.

Decision of County Court

The Fayette County Court in a voluminous opinion rendered on Dec. 26, 1922, held that discharge by the defendant coal companies of the water accumulating in their mines into Indian Creek was a proper and natural use of their lands, and constituted a right of property of which they could not be deprived except by due process of law; that the Mountain Water Supply Company had not lawfully acquired any of the property or property rights of the defendants, and hence its rights to the water were simply those of a riparian owner, and as such had no standing in a proceeding to enjoin the discharge of mine drainage into the stream; that the public use of the water was not a controlling factor because none of the plaintiffs had completely exercised power of eminent domain devoting the waters to public use, and finally that granting of the injunction would deprive the mine owners of their rights without due process of law. The decree of the Court refused the injunction and dismissed the case, placing the costs upon the plaintiffs.

Decision of Supreme Court

The case was appealed to the Supreme Court of Pennsylvania, and an opinion rendered on Sept. 29, 1924, held that the lower Court was in error in holding "that to constitutue a public use of the water it must be taken under the right of eminent domain"; concluded that the water was devoted to public use; that the Sanderson case did not apply, "that the defendants have no right of any kind to drain their mine waters into the stream considering the public use which is made of its waters, and that their so doing constitutes a nuisance which must be restrained."

The decree of the lower Court was reversed, and it was directed to enjoin the defendants from "discharging, pumping or causing or permitting to flow or to be discharged, any drainage of mine water from their mines, and from the mines of each of them, into the waters of Indian Creek, or its tributaries, above the dam of the Mountain Water Supply Company, after the expiration of six months from the date of the entry of the decrees. It is further directed that defendants shall pay the costs."

Following the decree of the Supreme Court of Pennsylvania, the defendant coal companies sought to have the Supreme Court of the United States review the case, stating among other reasons that the action of the State Court had deprived them of property without due process of law, and that they had been denied equal protection of law in violation of the Constitution of the United States. After hearing briefs and argument the Supreme Court of the United States refused to give consideration to the case.

Following this refusal of the Supreme Court of the United States, and in conformity with the decision of the Supreme Court of Pennsylvania, an injunction was issued by the Fayette County Court on Jan. 29, 1925, giving the coal companies until July 30, 1925, to comply with the order of the Supreme Court and cease the discharge of mine drainage into the stream.

Sufficient time has not elapsed to gage the effect of this decision upon the coal mining industry and the mine drainage pollution problem of Pennsylvania. This much is certain, it constitutes a brake upon the indiscriminate destruction of water supplies by mine drainage, which has been carried on so long by the coal companies under the apparent protection of the Sanderson cases.

ORGANIZATION OF CATERPILLAR TRACTOR CO.

All of the assets and rights of the Holt Manufacturing Company of Peoria, Ill., and Stockton, Cal., and of the C. L. Best Tractor Company of San Leandro, Cal., are being purchased by the Caterpillar Tractor Company, a new corporation organized under the laws of California, with an authorized capital stock of $12,500,000, the principal business of which will be that of manufacturing and selling the combined product of the concerns included in this merger.

The board of directors of the Caterpillar Tractor Company will consist of C. L. Best, R. C. Force, B. C. Heacock, O. L. Starr, of San Leandro, Cal.; P. E. Holt, of Stockton, Cal.; Allen L. Chickering, Harry H. Fair, John A. McGregor, of San Francisco, Cal., and Murray M. Baker, of Peoria, Ill. The official staff will be as follows:

C. L. Best, Chairman of the Board; R. C. Force, President; Murray M. Baker, Vice-President; P. E. Holt, Vice-President; B. C. Heacock, Vice-President and Secretary; O. L. Starr, General Factory Manager.

The combined sales of the two constituent companies for the year 1924 were approximately $17,500,000. Trade indications at the beginning of this year point to a largely increased volume of tractor sales for 1925, and the sales to date amply confirm these indications.

"Caterpillar" and "Track Layer" tractors have become standard equipment in many important industrial activities, particularly in the fields of road building and maintenance, contracting, grading, logging, snow removal and agriculture. During the period since the war, the quality of these tractors has materially broadened and their use is rapidly extending into many new fields of activity throughout the entire world.

The new company will own the following plants:

(a) The Holt Manufacturing Company, Peoria, Ill., a plant occupying 40 acres of land, of which 14 acres are under roof. A plant fully equipped for the manufacture of 5,000 "Caterpillar" tractors per year.

(b) The C. L. Best Tractor Company, San Leandro, Cal., a plant occupying 10 acres, of which 5½ acres are under roof. Fully equipped for the manufacture of 2,500 "Track-Layer" tractors per year.

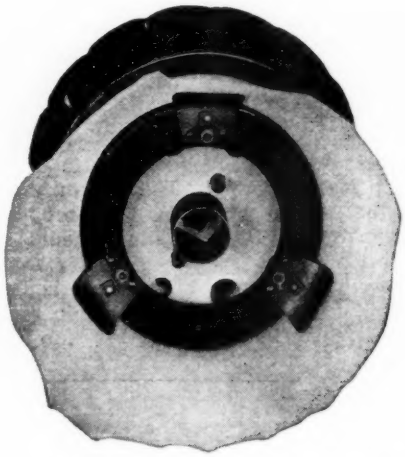
(c) The Holt Manufacturing Company, Stockton, Cal., a plant occupying 21 acres, of which 12 acres are under roof. Equipped for the manufacture of Combined Harvesting Machines and for the manufacture of miscellaneous parts and sub-assemblies.

All these properties will be owned by the Caterpillar Tractor Company in fee, and constitute, probably, the largest, most efficiently equipped and operated combined facilities in the world for the exclusive production of tractors of sizes applicable to industrial and agricultural purposes.

NEW GLOBE HOLDER CUTS MAINTENANCE COSTS

The Jiffy globe holder, designed to eliminate globe breakage and to economize in the maintenance of ornamental lighting systems, has been placed on the market by the Westinghouse Electric & Manufacturing Company.

This device permits the removal of the globe almost instantly, provides quick relamping and has a number of other low maintenance features. The mechanism of the device is simply constructed and easy to operate. By simply shifting a lever a catch is released and the globe is easily lifted out. It may be replaced with equal facility but can be re-opened only by manual means as the device locks automatically.



VIEW OF NEW GLOBE HOLDER SHOWING HOW GLOBE IS HELD IN POSITION.

The globe rests on a resilient seat and is secured in position by resilient phosphor-bronze grips. Screws do not come in contact with the glassware at any point. The globe holder is shock absorbing and will prevent breakage of globes due to wind storms and jars or impact to which street lighting standards are often subjected. An adjustment is provided for the variation in tolerance in globes of various sizes. Provision is also made automatically for expansion and contraction due to the elements.

EXPERIENCES WITH SMALL SERVICE PIPES

By J. E. Gibson, Manager and Engineer, Water Department, 1½ George St., Charleston, S. C.

The service pipes of a distribution system may be compared to the ganglia nerves of the human body. This is easily demonstrated when something happens to the consumer's supply line, for the difficulty or trouble is at once telephoned to the superintendent or manager at the office, with a very direct and explicit command that the matter be remedied at once. You may also compare them with the fibre root tendrils of a growing tree, for if the water department does not put out these tendril services the revenue with which to operate will be negligible. It will be seen, therefore, from these comparisons the necessity for satisfactory services if we are permitted to live our allotted time.

In Mr. Wellington Donaldson's paper, presented at the New York meeting as a contribution to work of Committee No. 10 on Standardization of Services, he fully covered the action of water on service pipes. It is not my intention, therefore, to go into this phase of service pipe troubles to any great extent, but rather to put before you a plea for better service pipes, and my efforts and experiences in eliminating the mechanical difficulties with our service pipes at Charleston, South Carolina.

We, in the water works business, have no code corresponding to that of the National Electric Light Association and the Underwriters Association for the electrical installation and wiring of buildings. It is true we have a plumbing code and ordinances in most cities and towns, but these codes usually consider the drainage plumbing only. This is probably due to the fact that water can do very little damage should it run amuck in the building. Defective wiring may cause death and total destruction of the property, whereas the damage from water is usually limited to ruined papering and falling plaster. This, nevertheless, should be no excuse or reason for continuing our present practice of indifferent service pipe installation.

When water companies first came into existence the water works men insisted upon the consumer's plumber furnishing service pipe and laying it to the main in the street, the water department reserving to itself the right to tap its main, and for which it charged a small fee. Naturally, the plumber in his desire for profit furnished the cheapest material with which he could get away under the contract. The water department, to a certain degree, had the same motive in that they desired consumers; and probably they reasoned that it was best not to insist upon a too rigid inspection. These desires probably explain the haphazard type of service now so common.

The cost of maintaining this class of service in the early days was relatively small. Paved streets were unknown, except in the most progressive cities, and when leaks occurred they soon found their way to the surface of the ground as there were no underground structures —sewers, conduits and drains—to carry the leaking water away. In this day of modern pavements with a multiplicity of sub-surface structures, sewers, drains, conduits, etc., the cost of locating and repairing leaks in our small service pipes compels us to pay attention to and adopt a much higher class of construction, both as to material and workmanship.

We also suffer from another difficulty, due to having "grown like Topsy" without restraint or training, in that one consumer applies for an inch service, and another consumer thinks he must have an inch and a half service, although his demands and requirements may be less than those of the first. Fortunately, however, in more recent times we have realized our mistakes and have adopted a service charge based upon the size of the meter or tap and this has corrected, to a greater or less extent, the desires of the consumer for an impracticable size service pipe.

We feel that it is the duty, yes it is incumbent upon the water department, to adopt a smaller size of service pipe for residential properties, and to advise with the architects and builders as to what is the proper size of service pipe to give them satisfactory service. It has been our experience that this phase of building construction is often left to guess rather than scientific design or thought, with the result that the owner often finds himself without adequate water supply or with a high minimum charge.

We have at present galvanized iron or steel; galvanized iron or steel lead lined; galvanized iron or steel cement lined; lead pipe throughout; lead tin lined and tin throughout; copper, brass and cast iron service pipes, all with or without

lead goosenecks as the custom in each locality may dictate.

Usually all service pipes are attached to the mains by some form of brass or bronze corporation cock screwed into the main, and at the curb there is usually placed another cock for the control of the supply to the building or buildings without the necessity of going to the street main. In all cases where service pipes with lead goosenecks are used the custom, to within the past ten years, has been to use a wiped joint, the ends of the gooseneck being furnished with a brass or bronze nipple for connecting to the galvanized or steel service pipe. During the past ten years, however, there has been developed a bronze lead to iron flanged cooupling where the lead pipe is flanged out, forming a seat in the union of the coupling, and the iron or steel pipe is screwed into the opposite end of this union coupling. Where lead pipe is used throughout the service, the connection to the corporation cock and the curb cock has been made with either a wiped joint or lead flanged coupling. This method of connection applies to all of the types of service pipes enumerated above wherever goosenecks are used. In cases where goosenecks have not been used, it has been the custom to use some form of swivel joint screwed thread fitting to take care of any settlement in the main or service pipe so as not to pull out or break off the corporation cock.

Recently there has been developed a soft brass and copper service pipe, using standard wrought iron pipe threads and fittings. There has also been developed a soft copper pipe using a flanged bronze coupling without threads, the joints being made in a similar manner to those of the lead flanged coupling above referred to. I have had no experience with either of these latter type services and, therefore, in the following remarks you will understand that I refer principally to galvanized iron or steel services with lead goosenecks or with all lead services. I do not want you to feel that I believe that any type of service can be used universally throughout our country. The local conditions as to soil, water or paving will have to be considered, but I do want to stress the importance of the service pipe, and the necessity of giving it in the future more attention than we have given it in the past.

Some water departments make only the tap, depending upon the plumber to do all of the rest of the work. I am unalterably opposed to this method, and believe that the Courts have rightly condemned it. The water department, either private or city, is the only responsible party and should be the only one permitted to open up the street or maintain property within the street limits. Therefore, I feel that the service pipe from the water department's main to the property line should be laid by the water department who should have the entire responsibility as to its maintenance. I feel, however, that the first cost of installation of this service pipe should be borne by the consumer, unless the law and city ordinances are such as to permit the water department to make an annual frontage charge on all property where service pipes are installed, without regard as to whether the property is being used or not. My preference is to have the consumer pay the first cost of installation which acts as a perpetual bond of his intention to consume water of the department.

Let us now consider the service pipe, commencing at the main and extending through to the property line.

1. The Tap or Corporation Cock: Should it be placed on top or at 45 deg. or 90 deg. from the vertical? Condition, depth of main, will probably govern, but I personally am in favor of about 45 deg. from the vertical in that it gives a nice easy operation of the tapping machine in installation and permits of an easy bend of the gooseneck away from the main. It gives ample opportunity for settlement of the main with a minimum likelihood of snapping off the corporation cock.

2. Should the corporation cock extend through the wall of the main? Some will say "no," but I am coming to believe that it is good practice to have this corporation cock extend through and into the main, possible ¼ in. as a minimum. In our experiences at Charleston during the past three to four years, where we have had occasion to renew hundreds of service pipes, removing numbers of corporation cocks, we have found the tuberculation and rusting over of the opening in the main beyond the end of the corporation cock to such an extent as to reduce the opening to about ⅛-in. in the case of a ¾-in. corporation cock; and in a few instances to actually close up the opening entirely. Had the cock extended into the main, say ¼ in., I cannot conceive of

this condition having occurred under any circumstances.

Lead Goosenecks—Wiped Joints

Lead goosenecks with wiped joints have given satisfactory service in, by far, the majority of our cities, but occasionally we find that, due to soil conditions, wiped joints are not satisfactory. This is the case at Charleston where we have a low coastal peninsula, with high saline ground water. There seems to be a galvanic action that soon destroys the amalgamation with the brass nipple so that the joint leaks, and it is our practice to use altogether a lead to iron union.

Probably 90 per cent of the water companies throughout the country use galvanized iron or steel pipe for their service lines, and in many cases there is little or no trouble. However, with filtered waters, low in alkalinity, or relatively high in carbonic acid, the results are not satisfactory. Considerable trouble from tuberculation and incrustation is had with the accompanying red water troubles. Galvanized iron or steel is admirable in one respect; that is, it is not easily injured by other operations in the street and will stand considerable abuse before being punctured, flattened or broken. In acid or saline soils galvanized iron or steel does not have a long life.

Curb Cock

We next come to the curb cock . Usually this gives relatively little trouble, particularly if it is the inverted key type, roound way opening, but it does give trouble. It is primarily for the control of the water to the premises, to avoid having to dig up the main to reach the corporation cock, and is for the exclusive use of the water department. This latter use, however, is not restricted as the owner and plumber feel that they have a certain proprietary interest in it, and usually the troubles with the curb cock are due to these extraneous uses. Here, again, we have the question as to whether the service pipe ends at the curb cock or extends to the property line. I think the service pipe properly should extend on to the property line. I understand that in some localities the curb cock is put at the property line rather than at the curb line. Our practice at Charleston, however, is to put it at the curb line.

Meters

It is, I believe, becoming almost the universal practice in the South, where frost is not severe, too place the meters at the sidewalk either at the curb line or just inside of the property line. In the North, where frost extends downwards several feet, this is not possible nor desirable; but the practice certainly does lend itself to easy reading, inspection and maintenance of meters, as you are relieved of all delays due to absence of owners or tenants of properties. At Charleston, it is our practice to set the meter in the service pipe immediately behind the curb cock. We use a 7½-in. cast iron brass meter coupling which permits sufficient space between the meter and curb cock to allow for the setting of the meter box. The meter is set about 15 ins. below the surface of the ground, and we have yet to experience a frozen meter where the meter was actually in contact with the ground at the bottom of the meter box.

Lead Service Pipes

Lead as a material for water conduits has been known and used as long as any other material; in fact, we know that the earliest Roman water supplies used lead pipe for conduits and, therefore, under normal conditions there can be no objection to lead for service pipes. Mechanically, the objection is that lead services are easily injured by other operations in the street, such as being flattened or pierced by picks and shovels and where there is a saline soil and wiped joints are used, galvanic action may occur that weakens the wiped joint. Chemically, some waters attack the lead and dissolve it, in which case of course lead poisoning may result. I have in mind a case in South Carolina where the water supply was from deep wells very low in carbonates and relatively high in carbonic acid where the lead was dissolved more or less rapidly; particularly on service pipes where the water was being used regularly. This condition was corrected, and the entire trouble relieved by the use of a very small amount of soda ash in the receiving well from the pumps.

Lead has so many advantages that it, to my mind, forms the most acceptable material for service pipes. It is noncorrosive from acids in the soil, does not incrustate or tuberculate, is easily manipulated, can be bent to easy curves around obstructions such as sewers, drains and conduits and when installed by competent workmen gives no trouble at all.

Further, if it becomes necessary at any time to remove the service and install a larger one the old material has a high salvage value, which is not the case with

any of the other materials now being used.

Lead Tin-Lined Service Pipes

I have had no experience with this class of service pipe material, but I judge that it has about the same mechanical difficulties as the regular all lead. Chemically, however, it offers greater resisting qualities to the corrosive action of the water, and the danger of lead poisoning is practically removed.

Lead-Lined Galvanized or Steel Service Pipes

This composite material combines the many advantages of the two metals, the galvanized iron or steel protecting the thin walled lead pipe from mechanical injury, and the lead lining, in its turn, protecting the galvanized iron from internal corrosion. The danger from lead poisoning with certain waters is still present. It is installed the same as standard galvanized pipe, except slightly greater care is required not to injure the lead lining. Fittings are furnished with lead lining so that when the joints are made up the interior presents a continuous lead surface.

In soils that attack the galvanized iron or steel pipe, it offers no advantages over ordinary galvanized iron pipe. The jacket or iron casing is eaten away and the lead lining, being too thin to withstand the pressure, bursts. It has no salvage value such as the all lead service on account of the difficulty of removing the lead.

Lead-Lined and Tinned Galvanized Iron and Steel Services

No general remarks are necessary as to this material other than to say that it combines the several advantages of the individual composites.

Galvanized Iron Cement-Lined Service Pipes

I have had no experience with this material, but I can see that it has many advantages and where the soil is such as not to attack the galvanized iron, I would think it would be ideal as my experience with cement lined cast iron pipe and thin walled wrought iron pipe has been very satisfactory indeed. Tuberculation or incrustation does not take place, and the carrying capacity is maintained indefinitely.

I should think it would require great skill in installation and would not be susceptible to bending to any great extent. To make it satisfactory, fittings should be cement lined also.

Brass Service Pipes

Brass or bronze has been known and used for ages in the manufacture of cooking and distilling vessels and for containers of liquids. It is particularly resistant to action of water and was used for steam pipes, boiler tubes and heater tubes almost universally in the early steam days, both in land and sea service. It is still used almost without exception for condenser and heater tubes.

The economical and commercial developments of mining and manufacturing copper have so reduced the price as to bring this material within reach of competition with iron and lead pipe for services. Within the past few years there has been placed upon the market a semi-annealed and soft brass pipe, iron pipe sizes, that can be cut and threaded with standard iron pipe tools. This pipe has many advantages. It combines all of the admirable features of the iron pipe, being easily cut, threaded and installed, having freedom from mechanical injury from other operations in the street and being practically free from incrustation or tuberculation, and chemically resistant from corrosion except under conditions that are not often met with in water service.

I have had no experience with this type of service pipe but the objections, as I see them, are:

1. Lead goosenecks will have to be retained.

2. Mechanically, unless the pipe is well annealed, it will probably open up or split along the seam. This is probably the most serious objection, from my viewpoint, as my experience wtih brass nipples has been very disappointing; so much so that we insist upon only cast brass nipples being used upon our service pipes and connections.

(I recall an office building in Philadelphia plumbed throughout with brass pipe, and a most excellent job. However, split pipes were not an unusual occurrence 15 years after the completion of the building.)

3. Greater care will have to be used to secure good threads to avoid leaks so our enemy, rust, will not step in and make rust joints for us when we use this material.

Copper Service Pipes

About the time that the iron pipe size semi-annealed or soft brass or bronze pipe was brought out, there was also placed upon the market a light gauge copper service pipe. This pipe comes in various lengths, the longest being 20 ft.,

and the joints are made by flanging out the ends of the tubing and using a collar spherical union very similar in design to the well known iron pipe to lead flanged coupling.

Again, I must plead ignorance of having had any actual experience with this material other than that of making a joint at one of our state conventions. Undoubtedly, this material has advantages over all of the service pipe heretofore enumerated and has only a limited number of their troubles. Briefly, its advantages may be stated as follows:

1. Soft copper easily flanged and very flexible. It can be bent around obstructions.
2. Elimination of lead goosenecks.
3. Light in weight and easily handled.
4. No threading required to be done in the field. Flanging can be done with small anvil and swedge so that unskilled workmen can make a joint.
5. All thread cutting and fitting done on special parts and furnished in the form of fittings.
6. No jointing compounds or grease required as all joints depend upon compression of the soft copper between finished relatively hard bronze surfaces.
7. Tools required in the field reduced to a hacksaw and two monkey wrenches.
8. Uniform class of material throughout service, eliminating galvanic action between dissimilar metals.
9. Non-corrosive from external and internal conditions.

The objections are:

1. lightness, or rather the thin wall permits of its easy collapse by a blow or from the weight of rock or dirt in backfilling.
2. Injury from other operations in the street.
3. Probably less salvage value in case of replacement.

None of these materials in themselves will cure the red water plague because the principal offender is the house plumbing, and the house will continue for a long time to be with iron pipe.

I can see no hope of getting entirely rid of the red water plague until we use some non-corrosive or rust resisting protective coating throughout the entire water works system, including the house plumbing.

The "proof of the pudding is in the eating," so in service pipes the material that gives the best results in your plant under the existing conditions is probably the proper one for you to use. There are other troubles, however, besides those of material.

Workmanship and Labor

The men entrusted with the installation of your service pipes should be thoroughly reliable, trustworthy and honest and should be instructed carefully as to how the work should be done, and that under no circumstances should any work be covered up until inspected and tested.

Good tools and equipment should be furnished and maintained for their use. All pipe should be cut with a hacksaw rather than with a wheeled cutter, and if cut with the wheeled cutter the burr should be reamed out. My objection to the wheel cutter is that it requires reaming afterwards and under stress or oversight this reaming is more often omitted than done.

Location

The service pipes should, in all cases, enter the consumer's property from the front or street upon which the building faces and is numbered, without regard as to whether the building is situated upon a corner or not. This precaution is necessary to avoid confusion in records, and to enable the department to render quick service in case of necessity.

Driveways should be avoided on account of paving and annoyance in case repairs are necessary.

Other service ditches, such as sewers and drains, should be avoided. This is necessary to protect the service from injury due to other workmen working in the street. The drains and sewers are usually at a lower elevation, and if service pipes are laid in these same ditches settlement occurs which may break the water service pipe. Further, in case of repairs to other pipes at lower elevation, the service pipe must be supported and it is seldom, if ever, securely supported during repairs or protected and supported in backfilling. If leaks occur and they find their way to the drain, they may undermine the street surface should the drain be defective.

Depth

The frost line will probably dictate the depth to which service pipes are to be laid. The nature of the soil and type of paving will also have to be considered. The danger of injury from traffic is greatly reduced when the streets are paved, the critical period being that time during paving operations. The minimum depth,

however, in our judgment is 15 ins. below the subgrade of paving and 24 ins. in unpaved areas. For cold climates the frost line will necessitate greater depths.

Placing Services in Advance of Paving

Put this phase of service pipes in the "DON'T" column first and last items. It is an economic waste. Location and size are never satisfactory. If paid by consumer it is always a sore spot, and if paid by water department it places an undue hazard in unprofitable investment and a perpetual menace in maintenance, and usually nine times out of ten when finally required there is something wrong, necessitating opening up the street at the main anyway. The capital and interest on this type of utopian investment to save cutting open a new paving would more than pay for repaving the streets, in many cities.

The foregoing paper by Mr. Gibson was read at the 1925 meeting of the American Water Works Association.

THE PUBLIC AND HIGHWAY TRANSPORTATION

By the Hon. W. M. Jardine, Secretary of Agriculture, Washington, D. C.

Within the last two centuries there have been developments in transportation facilities which have been recognized by the public as improvements over preexisting modes of travel. New users of the highways have sprung up from time to time who have found a way to move persons and goods more expeditiously, more cheaply or with greater comfort. The flying stage coaches of early days constituted such an improvement over the pack horses that preceded them, but they were not so recognized by the owners of pack horses. The railroads at a later time wrought much greater improvements; and if you think that they were essentially different from the earlier improvements merely because they were privately controlled, I call your attention to the fact that practically all important roads of the time when the railroads were coming into existence were privately controlled and financed by tolls. Certainly the railroads were acclaimed by the public with the same enthusiasm which greeted the appearance of the stage coaches; and certainly, also, they met the same resistance from the stage coach operators and others, whose business interests were affected.

The latest of the "new users" is the motor vehicle. Its reception by the public has been of a kind with the welcome extended to all the earlier improvements in transportation facilities. There is no doubt of the warmth of that reception. In less than 20 years the number of motor vehicles has grown to more than seventeen million. But, along with the praises that have been heaped upon it we have the murmuring of those who fear that it will lead us to no good end. Now we have reached the stage where the suggestions for restrictive regulation have begun to multiply, some of which are humorously similar to those which sought to curb the operation of the flying coaches.

I have faith that in the long run the motor vehicle will find its place in the whole scheme of transportation naturally and inevitably as have all the earlier "new users" of the highways; but we may help it to find that place by wise restraint of its more enthusiastic proponents and by refraining from regulation which may have a crippling effect.

The public is not yet in a position to define definitely its field of operation with respect to those of the older transport agencies. The actual division of the field can best be made by the representatives of the various agencies on the basis of facts established by an unbiased study of their relative service values. In such conferences as this in which you are now engaging it should be possible to reach agreements which will result in the development of all systems of transportation on a basis of mutual cooperation. As a basis for your discussions, however, I should like to urge upon you the desirability of seeking out the facts of the situation. Mere opinions are seldom a reliable basis, because so many of the things we think we know are simply not so.

In the Department of Agriculture we have come to feel the need of facts very keenly, because we have had imposed upon us by Congress the responsibility of administering the Federal highway act. We take that responsibility very seriously. As we view it our job is not merely the building of a large mileage of road. We look upon the roads as the means to an end—not as the end itself. The end is the improvement of transportation in the United States.

To serve as a basis for the improvement of the roads, in cooperation with

the State highway departments, we have made very complete and careful surveys of the use and the limits of use of the highway systems of Connecticut, Maine, Pennsylvania, California, Tennessee, and Maryland. Recently in cooperation with the Board of County Commissioners and Mr. Quinlan we have completed a similar, but even more intensive investigation here in Cook County. We are going farther. We intend to examine the conditions in other states as rapidly as our forces can handle the work.

On the basis of what we have already found I feel that I can talk to you as one having authority in regard to some of these matters on which there are so many opinions. In other words, we have the definite facts.

One thing we know very definitely—there is no basis for the fear that the motor truck is going to compete seriously with the railroads. The facts we have found in all our surveys are sufficient to convince me. The truck has found its place in the short haul, and it is not taking over any business that the railroads can do as well or better.

In Connecticut we have found that nearly 40 per cent of the total tonnage is moved less than 10 miles and nearly 70 per cent less than 30 miles. The movement which runs to 100 miles and over is largely a movement of furniture and household goods in which promptness of delivery and a minimum of handling are the controlling elements. In that state we have found that two factors are, in general, responsible for the transportation of commodities by truck over 30 miles. The first is the lack of the rail service which would enable shippers to obtain rapid and dependable transportation of l. c. l. freight. The second is the one I have mentioned, that certain types of commodities, notably furniture, but including also groceries, meat and vegetables distributed from the cities to the smaller towns, are in their very nature adapted to motor truck shipment.

Jump clear across the country to California and you find the same situation. The difference is one of degree only. There we find that 25 per cent of the total tonnage is hauled less than 10 miles and 60 per cent less than 30 miles; and the tonnage that is hauled more than 70 miles is less than 20 per cent. The reasons for the greater long distance movement are fairly clear. They are the greater distances between cities and the less complete service afforded by the railroads.

Come back to Cook County and you find the same story, again differing only in small degree: 24 per cent of the movement is less than 10 miles; 75 per cent less than 30 miles; and less than 3 per cent moves farther than 100 miles.

These are the facts in regard to the length of motor truck hauls in three typical areas in three widely separated sections of the United States. They are not arm-chair opinions. Our observers have gone out on the roads; they have stopped the trucks and asked the drivers where they were going and where they came from. We stand on these figures, and I think they prove very conclusively that the truck is not invading the long-haul field.

There was a time, no doubt, just after the war when enthusiasts thought they could see the truck taking the place of the railroad completely—at least they talked that way. But that time is past; and the reason for its passing is that the long haul doesn't pay—and truck operators know it doesn't. It has been tried—we seldom learn anything except by bitter experience. One of the most reputable haulage companies in the United States tried it, and kept a careful record of the costs, and the result is sufficiently discouraging. They operated a fleet of 35 trucks averaging 3½ tons' capacity between Buffalo and Erie and Erie and Cleveland. The distance is about a hundred miles in each case.

They based their rates on the railroad tariff—a little more for the low class commodities, a little less for the high class, but averaging fairly close to the railroad rates. And, on the basis of a year's operation, with $200,000 gross revenue, their net loss was $14,000.

But we have not limited our investigations to the study of the length of haul. We have weighed the trucks as well as counted them, and we have found out a good many other things about them, such as the kinds of commodities they carry and the type of service they render.

The service is distinctly a service of distribution from centers. In the main it is a service which neither the railroads nor any other inflexible carrier limited to a fixed line of travel—whether it be a rail line or a water line—can render. It is a service which does not aim to move

large bulk day after day and year after year between the same points. Its loads are picked up everywhere and hauled anywhere within the short-haul limit. It supplies materials for building operations today at one point, tomorrow at another. It distributes the daily bread directly to homes over an entire county. It supplies country stores with fresh meats, vegetables, with anything that needs to be fresh to be good. It collects milk from hundreds of farmers within a 50 mile radius of the cities and brings it to the city milk plant for pasteurization and redistribution. It is used by farmers collectively to send their truck to market, and get back their city purchases. Within the short-haul limits it is taking some of this business away from the railroads, but it is taking it because it can perform better service. Nothing can prevent it from taking that business, and the railroads should be glad to see it go because it never has really paid the railroads.

Perhaps I may illustrate how the highways are being utilized by a brief reference to the situation we have found in respect to the transportation of milk. We have made special studies of the milk movement in the Chicago, Baltimore, Cincinnati, Detroit, Indianapolis, Milwaukee, Philadelphia, St. Paul and Minneapolis markets. In all these markets, with the exception of Chicago, Philadelphia and Baltimore, the studies show that approximately 90 per cent or more of the milk now received is transported to them by motor truck instead of by railroad. Philadelphia receives only 20 per cent of its milk by highway, Chicago 32 per cent, and Baltimore 45 per cent, and in each case the lower percentage is probably accounted for by the fact that these larger cities, because of their heavy demands must draw their supplies from an area so large that the shipping distances become too great for motor truck hauling.

Since we are in Chicago suppose we take the delivery of milk to this city as an example. In 1910, 94 per cent of the milk used in the city was transported by steam railroad, 2 per cent by electric railroads, and 4 per cent by wagons. Since then the growth of a circle of suburban towns and subdivisions around the city has gradually pushed the dairy farms back beyond a wagon's haul of the city, so that today none of the milk used by the city is delivered to it by wagon. But the motor truck now brings in 32 per cent of the city's supply and the percentage transported by the 26 steam railroads has been reduced to 68. Electric railroad shipments have ceased.

Mere percentages, however, do not make clear what has taken place in this 15-year period of changing transportation methods. Although the percentage of milk delivered to Chicago by rail has dropped from 94 to 63, the quantity delivered remains today almost exactly what it was in 1910; and although the railroads have lost to the motor truck a considerable part of the business within the short-haul zone of 50 miles, they have gone out beyond the normal trucking radius to develop the new producing territory which the growth of the city demands. There has been a considerable extension of milk mileage by railroads operating in territories where motor truck competition is especially keen.

From the standpoint of the producer the reasons which compel him to prefer the motor truck to the railroad within the short-haul zone are:

First. That the motor truck gives a market outlet for milk produced in territories which formerly were too far removed from rail shipping points to be reached by wagon.

Second. The motor trucks pass the producers' gate and furnish a complete service that can not be duplicated by the railroads.

Third. The driver of the truck is the producer's agent from the farm to the city dealer, and performs a marketing as well as a transportation service.

Fourth. Shipment by truck reduces the number of handlings from half a dozen or more to only two.

Fifth. The farmer loses fewer cans.

Sixth. There is an estimated saving of 5 cents a hundred-weight on all milk trucked in by the elimination of the haul from the railroad milk platform to the city milk dealer.

And last, within the short-haul limits the motor truck makes possible an actual saving in time of delivery from the farm to the city milk plant of an hour or more by the reduction in handling and the elimination of the hauls to and from the railroad at the two ends.

Similarly, we find that the motor truck is used to a very large extent in the movement of livestock from the farm to the packing centers. In the Indianapolis market, for instance, it has been found that more than 30 per cent of the

total receipts of hogs for the year are delivered by truck. Ten years ago such deliveries constituted only 5 per cent of the total receipts. Today within a 50-mile radius of the yards 90 per cent of all hogs raised are moved in by truck.

These illustrations, drawn from the facts as we find them in our surveys will serve to indicate to you the nature of the service that is being rendered by the motor truck. Although, in each case, they point to a transfer of business from the railroads to the highways, you will observe that in each case the business transferred is limited to a short-haul movement. Similar studies of the movement of non-perishable agricultural products, especially those which are shipped long distances in bulk, or the movement of the products of mines and forests, would reveal a different situation. Apparently the motor truck is finding its place very naturally. It has not yet shown an indication that it will ever function satisfactorily except on the short haul. But it is proving itself a valuable supplement to the railroads in the local field, and in the vicinity of the terminals.

I am glad to see that its usefulness in these fields is being recognized by railroad officials. I am especially interested in the experiments now being made by the Pennsylvania Railroad in which the motor truck is being used as a coordinated agency for the handling of local, less-than-carload freight. Operating on the zone-station principle by which full cars of package freight are shipped to the zone stations and from these delivered to the intermediate stations by motor truck, I am told that the company has been able to speed up its local package service and reduce by 75 per cent the damage to goods in transit. In addition it is hoped that the selection of the zone stations in such manner that the trains will not have to cross over against the stream of traffic will materially increase safety in train operation.

In the apparent success of this experiment by the Pennsylvania I feel that we have a hopeful indication of the more complete and harmonious utilization of the facilities of both the highways and the railroads which will enlist the support of all agencies in each field in the near future. The public demands better transportation, which means not only a cheaper movement, but more reliable service and more prompt delivery. It is convinced, I believe, that the motor truck operating over the public highways can be utilized effectively, in proper coordination with the railroads, to accomplish these ends. The growing utilization of the new vehicle must necessarily result in a transfer to the highways of some of the business formerly handled by the railroads. How important such transfers may become, and what will be the effect upon the older carriers remains to be determined, but we should bear in mind always the thought that these older carriers shall not be crippled in the process. The services which they must continue to perform are vital to the economic well being of the country. In their proper field they can never be displaced by any form of highway transportation yet developed, and their services in that field must not be rendered unprofitable by unregulated and unwise competition.

There is one other popular idea I feel disposed to deny. That is the idea that motor trucks are destroying our roads. I don't know why it should need denial, but apparently it does. Look around you. Are the roads getting better or worse? Have we ever before had such fine ones or so many of them? Have we ever before had fewer of them in a state of disrepair? Well, there are now as many motor trucks using these roads as there were of all kinds of motor vehicles ten years ago, but the cost of the roads per ton-mile of traffic is far less now than it was then. This has been accomplished, first, by the really notable improvements that have been made in the design of highway surface; second, by the building up of efficient administrative and engineering organizations; and third, by the greatly increased use which far exceeds the increase in the cost of the roads. Even in the state of Maine, remote as it is from the centers of big business expansion, our surveys show that highway traffic doubled from 1916 to 1919; it doubled again from 1920 to 1924; and we confidently expect it to double again by 1930.

The idea that trucks destroy roads is a hangover from the war period when they were actually destroyed, for two very good reasons: First, because the heavier motor trucks—then comparatively new—were suddenly released on roads which had not been built to accommodate them; and second, because at that very time the expenditure of money for high-

way maintenance was declared to be non-essential to the winning of the war and discouraged.

The roads we are building now are built to accommodate the traffic they will be called upon to carry, as determined by detailed surveys such as I have described. And they are maintained. They wear out just as rails and locomotives and motor trucks wear out; but they are not destroyed.

In the field of passenger transportation the public has already given abundant evidence of its intention. There is no arguing the meaning of the fifteen million automobiles now operating on the fast improving roads. The people want the kind of individual transportation which these vehicles supply. Doubtless a part of this service would otherwise be furnished by the railroads. There is evidence, indeed, that the passenger movement on certain branch lines of railroads may be so reduced as to be no longer profitable. But, in the main, I think it must be conceded that the automobile is functioning in a transportation field of its own, and is gratifying wants which could not have been met by the railroads.

Motor vehicles—both automobiles and motor trucks—which with the public highways constitute the facilities of modern highway transportation, do not need to plead for their place in the sun. Not long since they could perhaps be passed over as non-essential—a fad if you please. But not so now. The motor vehicles have given to highway transportation a new usefulness and the public has expressed its belief in them in the most powerful way it knows how—by the investment of billions of dollars of its capital in the more than 15 million automobiles and more than two million trucks.

Cooperation and coordination are the keys to the maximum usefulness of the new highway transportation. They are, in fact, the prerequisites of improvement in our whole transportation system—and they are needed all along the line. Road builders and vehicle manufacturers must cooperate in order that the roads shall be built to carry the vehicles and that the vehicles shall not overburden the road. The road building authorities of the nation, the states, the counties and the municipalities must cooperate that the roads which know no political borders shall be properly coordinated.

Railroad, waterway and highway transportation should be coordinated in order that each shall be developed to its highest point of usefulness without taking from another the functions which the other can perform to the better advantage of the public. Shippers and officials of transportation agencies must cooperate to eliminate unnecessary handling and reduce the time and cost of transportation. And finally we must develop a spirit of cooperation between the public and those who are working to improve transportation whether it be railway, waterway or highway transportation, to the end that the public needs will be met to the fullest possible degree and that a fair return upon the invested capital shall be assured to the agencies of transportation.

The foregoing address by Secretary Jardine was delivered at the Midwest Motor Transport Conference, held at Chicago, May 28, 1925.

THE RATIONAL DESIGN OF REINFORCED CONCRETE TANKS

Hewett System of Placing Metal Reinforcement under initial stress successfully used in construction of first leakless concrete water tank.

By Arthur S. Milinowski, of Druar & Milinowski, Consulting Engineers, 500 Globe Building, St. Paul, Minnesota

Recognition of the enormous advantages that would attend the consistently successful use of concrete as a material with which to build above-ground tanks for liquid storage, has led to numerous attempts so to use it. A hundred or two such tanks have heretofore been constructed. Many must be termed failures.

It is my purpose in this article to indicate the fallacies in the old method of design of reinforced concrete tanks which are responsible for the failures and explain the new and rational method of design that has recently been proved out in a water tank built for the Village of Barnum, Minn., the first of its kind. Although completed in the fall of 1922, I have purposely delayed a full description of the work until a thorough examination could be made of the structure after an adequate period of time.

Hewett Design

This new method of designing was originated and proposed to me by Mr. Wm. S. Hewett, member A. S. C. E., of Minneapolis, and the design of a reinforced

reservoir by Mr. Hewett's method was thereupon included in the plans for a complete water works system for the Village of Barnum, prepared by my firm, Druar & Milinowski, consulting engineers. The tank was completed and has been used for one and one-half years without difficulties of any kind and has solved the problem of the non-leaking concrete tank.

Fallacies of Former Methods—Non-Mathematical Discussion

The considerations entering into the design of reinforced concrete tanks differ fundamentally from those of any other type of engineering structure. In bridges, buildings, or other concrete structures intended to resist external load and in which metal reinforcement is placed not merely to resist temperature or shrinkage stresses, the reinforcement takes all or nearly all the tension forces, while the principal function of the concrete is to resist whatever compression may occur in the loaded member. Each material is intended to be employed to resist, without exceeding its elastic limit, that kind of stress to which it is best adapted. The combination of concrete and steel under such conditions is true "Reinforced Concrete." In tanks, mark well the difference, the stresses set up in both steel and concrete are tensional always. The hitherto universally used method of designing and constructing tanks actually allows tension in the concrete to a point beyond its elastic limit or even beyond its ultimate strength. The result is not "reinforced concrete" at all, but merely a nest of steel rods embedded in a mass of disrupted material that might have been real concrete.

REINFORCED CONCRETE TANK BUILT BY NEW METHOD AT BARNUM, MINN.

Here is apparently about the line of reasoning that we have heretofore followed: First we try designing a tank of plain, unreinforced concrete. Here it is necessary to make the walls heavy enough so that the hydraulic pressure will not stress the concrete anywhere beyond a limit considered safe, whatever this amount may be. This results in rather heavy walls at the bottom of the structure, diminishing in thickness toward the top and involving inconvenient and expensive form work, or if the walls are made of uniform thickness for simplicity's sake, a great waste of concrete. Besides, what engineer would be willing to trust the safety of such a structure entirely to the uncertain tensile strength of concrete? Obviously this won't do. So, as the second step, we try a concrete reinforced with circular steel reinforcement placed in the usual way before the concrete is poured. In order to keep the tension in the concrete, when the tank is filled, down to a safe working limit, a limit which will assure that no cracks, no matter how fine, may appear and allow seepage of water, we find again that heavy walls are necessary. Using a design based on the relative coefficients of elasticity of concrete and of steel in order to gain this desired result, we find that this is a very uneconomical combination of steel and concrete because the use of only a very small percentage of steel is required and the concrete is still called on to take a large proportion of the total tension caused by the water pressure—and concrete is an expensive material to use in that way. This method, therefore, also is discarded.

Next we try making the walls reasonably thin and decide to put enough steel in them to take the entire hydraulic load, and forget the concrete. The concrete is, after all, so we justify ourselves, merely a protection for the steel and a means of holding the water, which if necessary, we can waterproof on the inside and everything will be lovely.

Now, it is a very convenient thing to be able to do when something bothers us—just forget it. Unfortunately, Dame Science is extremely sensitive and severely resents any such slight. Yet this is exactly what we have deliberately done: Forgot what happens to the concrete. And see what *has* happened. As soon as the water pressure is applied, the concrete, stressed beyond its elastic limit before the steel has stretched enough to develop its full strength, fails. Not, perhaps, in one easily visible place, but in numerous fine cracks, and cracks don't hold water. Then we give the waterproofing contractor a job, and find that our structure is beautifully waterproof until the water is let in again. When we see the tank is still leaking, "Oh, yes, of course," we complacently answer, "The waterproofing has pulled apart, due to the expansion of the steel under pressure." The structure changes shape too much when we admit the water. This undoubtedly also caused the leaks where the tank shell joins the bottom. We will just pile in more steel and keep down the working stress and will anchor the shell more firmly to the tank bottom. Less stress, less deformation, smaller and fewer cracks in the concrete to have to waterproof. Just the thing! So our next tank is designed that way and on the day it is filled we invite our friends to come and a perfectly designed structure—fail. Again the attempts at waterproofing and this time, we firmly resolve that our next tank shall be steel.

Does this not sound familiar? Here is the trouble: Far from helping conditions, we have actually made them worse by placing more reinforcement in the concrete shell, for it has been demonstrated (Torata Matsumoto in Bulletin No. 126, Dec. 5, 1921, University of Illinois) that the forces due to the tendency of the steel to resist shrinkage of the concrete during setting may become great enough to stress the concrete beyond its elastic limit when the area of steel is only about 1½ per cent of that of the concrete and that the greater the percentage of steel, the greater this danger. Hence, with the old method, by the time the structure has set and is presumably safe to hold water, it has, if not already failed, at least a good start in that direction. On top of this we add the hydraulic load, give the steel its full stress and consequent strain, thus allowing the concrete to open up, and wonder why our tank leaks!

It is therefore apparent that in order ever to build successful concrete tanks, *the concrete must not be stressed beyond its strength*, either by shrinkage in setting or by the applied live load, or both. It is equally apparent that this cannot be done by the old method and still allow the use of a reasonably thin wall, or, what amounts to the same thing, that reasonably high proportion of steel area to concrete area which permits developing the full strength of the steel without depending on any great tensile strength of the concrete and which is necessary to economical design. The ideal concrete tank would be one in which the concrete is not placed in tension and in which the entire live load would be resisted by reinforcing steel. Incidentally, such a tank should have walls no thicker than necessary to meet the exigencies of practical field construction. Exactly these desirable results have now been accomplished.

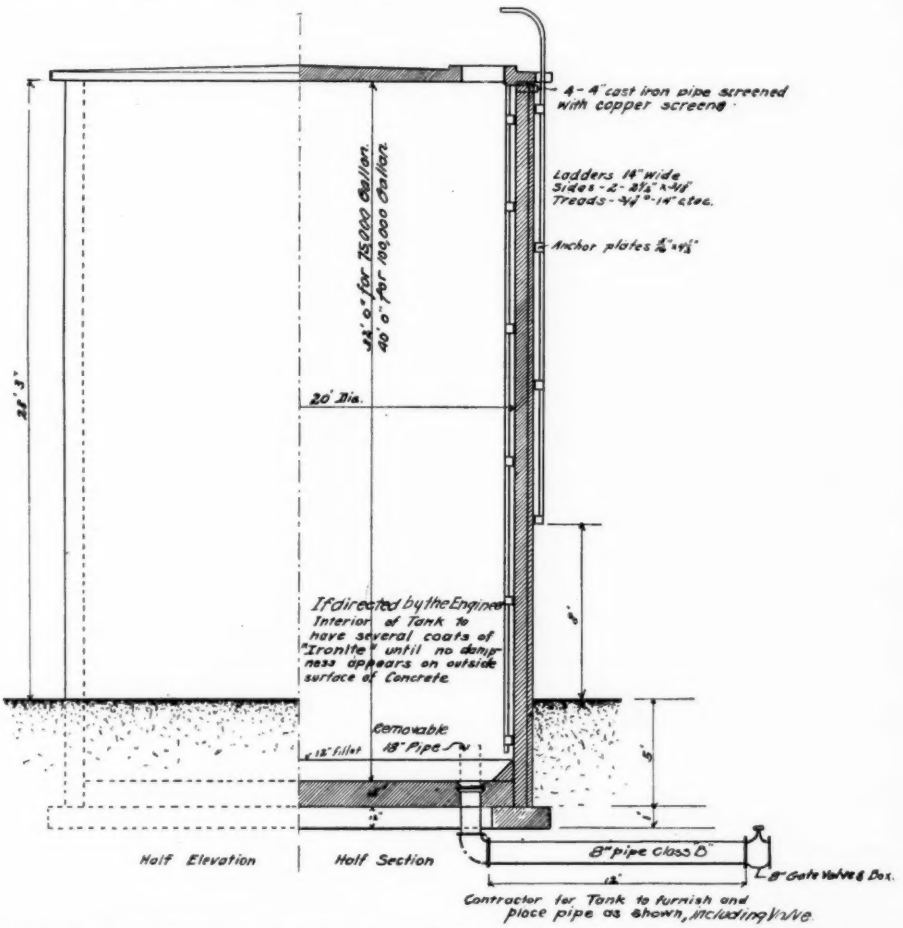
Mr. Hewett has pointed out the only way in which these conditions can be met. It is to build a comparatively thin tank shell first, of unreinforced concrete, allow it to set and shrink slowly by keeping it wet, thus letting the structure contract circumferentially, and hence also radially as much as it will, without restraining action of any embedded steel. Then to shrink into intimate contact with and onto the outside of the tank, steel reinforcing hoops, pre-tensioning them so as to give them a considerable initial tension and thereby placing the concrete under compression. Later an outer coating of concrete or gunite is placed over the whole to protect the steel. Under these conditions we have a true reinforced concrete, since the areas of concrete and steel and the initial tension in the steel are so proportioned that the stresses in neither, under any conditions, even with the tank full, approach their respective elastic limits. Hence their behavior together is amenable to mathematical analysis on the basis of the ratio between their elastic moduli and between their areas.

Such an analysis shows that when the water pressure is applied, the concrete gives up a portion of its compression while, at the same time, the stress in the steel is somewhat increased beyond the initial tension given it—but not, be it noted, to a point above a safe allowable

unit stress. This inter-action of the steel and concrete, resulting, when the hydraulic load is applied, in but a comparatively small increase of tension in the steel rods is distinctly at variance with preconceived notions, and the offhand judgment which most engineers reach when this idea is first presented to them is that if the rods are initially tensioned to the amount of the usual working stress, say 16,000 lbs., the hydraulic load equivalent of ten thousand or fifteen thousand lbs. per square inch more (these values being commonly used in the old designs where the amount of steel is about the same or even more than in the Hewett design) will bring the rods about to their elastic limit.

It requires a considerable mental wrench at first, used as we are to thinking of the full load in a tank being resisted by the steel only, to visualize this condition and to comprehend that the relative action of the two materials is governed by exactly the same laws whether the concrete, during the loading of the structure, goes from a condition of negative stress (compression) to zero stress, as in the tank shell built by the Hewett method, or whether it goes from zero to a positive stress (tension) as on the tension side of a beam; but so long as we remain within the elastic limits of our materials, this is absolutely true.

Hence, we can undertake our calculations with perfect confidence, with the assurance that the behavior of the completed structure will bear them out, as was proved by measurements made during the construction and filling of the Barnum tank.


4-4" cast iron pipe screened with copper screens
Ladders 14" Wide
Sides - 2 - 2½" x ¼"
Treads - ¾" ø - 14" etc.
Anchor plates ⅝" x 4½"
32'-0" for 125,000 Gallon
40'-0" for 169,000 Gallon
24'-3"
20' Dia.
If directed by the Engineer Interior of Tank to have several coats of "Ironite" until no dampness appears on outside surface of Concrete
Removable
18" Pipe
12" fillet
Half Elevation
Half Section
8" pipe class B
8" Gate Valves & Box
Contractor for Tank to furnish and place pipe as shown, including Valve

HALF ELEVATION AND HALF SECTION OF BARNUM (MINN.) REINFORCED CONCRETE WATER TANK

Mr. Hewett points out that after the inner shell has been built and while the rods are being tensioned, they, of course, crush into the concrete to the point where enough of the rod surface is brought into contact with the concrete so that the unit pressure of the steel rods exerted against the tank wall is equal to the compressive strength of the concrete. A further effect of this nature will result when the additional pressure of the water is applied and this effect may be further heightened by the repeated filling and emptying of the tank. This would tend to destroy the desired initial tension, and, therefore, it is necessary to obtain additional bearing for the rods after they have been tensioned; but before the tank is filled. His method of doing this is to deposit cement mortar behind each rod. This procedure becomes increasingly important the smaller the diameter of the tank and would be imperative for tanks or pipes of small diameter, say 6 or 8 ft. In the case of a 20 ft. diameter tank it was shown that this precaution might safely be neglected without incurring any risk of a loosening of the rods, from this cause, sufficient materially to affect the validity of the computations used in the design and the Barnum tank was filled with water without additional bearing having been first provided for the rods. In effect, the outer layer of the tank supplies this requirement.

One of the serious difficulties in the old method of tank design has been the making of a waterproof joint between the sides and the bottom. The efforts to overcome this have been exerted in two directions: Either the sides have been very rigidly anchored to the bottom, in which case detrimental and worrisome shearing stresses have been introduced at a point in the shell above the floor, or attempts have been made to provide for a more or less (usually less) free motion of the shell. Both these methods have caused much trouble. The new design provides for casting the floor before the rods on the sidewalls are tightened. Therefore the floor is compressed along with the shell. For this purpose, more hoops are placed at this particular point of the shell in order to take care of the extra resistance to compression offered by the floor. When the water is admitted, the bottom slightly expands again in unison with the shell, there is no bothersome relative motion between them and consequently no trouble in making a waterproof joint. This will be more readily understood when I state that the actual outward motion or deformation of the tank shell under water pressure is demonstrated to be only about 1/10 of the motion permitted by the old design.

Waterproofing

A word as to waterproofing. Concrete tanks leak for two reasons: Either because fine cracks open up when the concrete is stretched beyond its elastic limit or because the concrete itself is porous. It has been shown that concrete, if carefully graded and rich in cement, may be waterproof, but such results are expensive to obtain with thin walls in the field, both on account of the care required and the rich mixture necessary. Therefore, it may be cheaper to use merely ordinary mixtures and usual care and to depend upon a waterproofing of the inside of the completed tank. With the old design, waterproofing is a very difficult and uncertain operation. The wateproofing is necessarily applied under the conditions of "reservoir empty," when such cracks as may occur under pressure are again quite or nearly quite closed. Waterproofing applied under these conditions cannot successfully close them because the continuity of the waterproofing is broken as soon as the pressure is once more applied and the very large expansion allowed by the old design takes place. Porous spots in the concrete itself are just about as difficult to render permanently tight for the same reason, namely, the undue distortion under pressure. The new design does away with the first form of leaks entirely while the distortion of any part of the structure when filled is so slight as to make the waterproofing of porous spots in the concrete itself a certain, permanent and easy matter.

Comparison with Wooden Tank

I would here like to draw an analogy between the common wooden tank and Mr. Hewett's design. Of course, in wooden tanks, it was probably never thoroughly understood whether the watertightness was the result of a residual compression between the joints due, despite the water pressure tending to counteract it, to the initial tension of the metal hoops, or the result of swelling of the wood, but it is significant that wooden tanks, if carefully constructed, do not leak materially the first time they are filled and before the swelling action can take place. What else than a residual

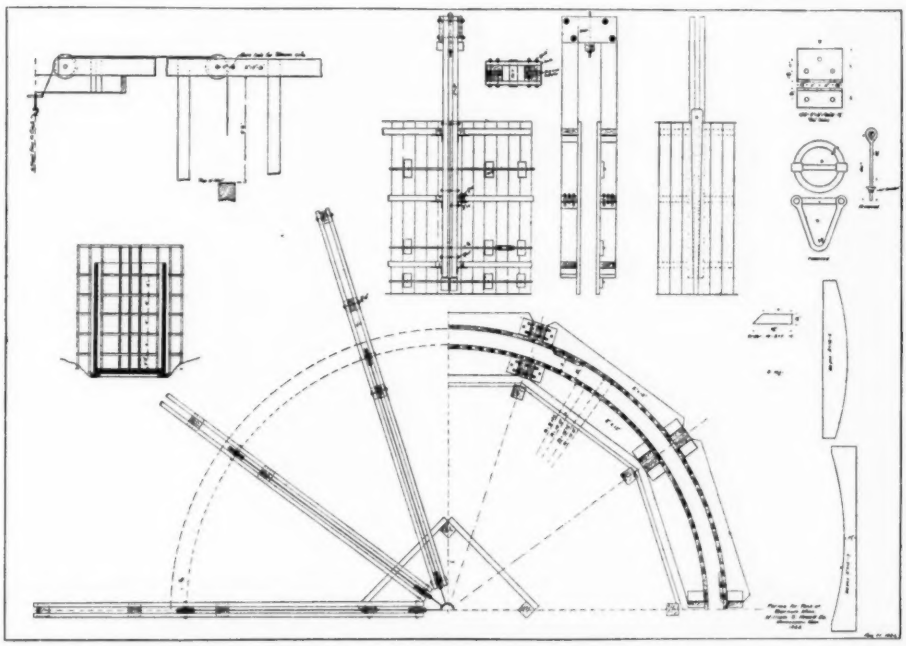
compression in the wooden shell, even under full water pressure, could produce this condition? Furthermore while the hoops on the wooden tanks are designed so as to take the full hydraulic pressure only, they are tightened before the structure is considered ready to hold water. Added to this initial stress soon comes the stress due to the swelling of the wood and still the tanks do not usually burst. If, therefore, we were correct in our assumption that the stress due to water is added in its full amount to their initial stress, the hoops would naturally be near the danger point of the elastic limit and the swelling of the wood should complete the failure of the tank.

Now it is plain that both in the case of a wooden tank and a concrete tank built on the same principle, absolute safety from failure could be assured by using an amount of steel computed under the assumption that the full hydraulic load actually is added to the initial tension and allowing an additional amount for stresses due to the swelling of the wood or concrete when wet. Such a design would be inexcusably uneconomical, unnecessary and hence not sound "engineering."

I have just mentioned this swelling of concrete when wet. Such behavior is now a recognized fact, but it is not a serious matter and in any otherwise conservative design according to the Hewett method its effect would not compromise the safety of the structure. In order to eliminate its effects, however, it is only necessary to have the concrete wet when the rods are being tensioned. Similarly, temperature stresses may be neglected in the design of tanks for ordinary purposes and their effect need only be considered in tanks designed for the storage of heated liquids.

Effects of Temperature Variations

The effect of variations of temperature on tanks of this sort are two-fold, manifesting themselves, first, in an expansion or contraction of the entire structure and second, in internal and more or less localized stresses. The former effect, as the simplest computation will show, is not of great importance, because the movement resulting for even an extreme temperature range is slight, since concrete and steel have very nearly the same coefficient of expansion. The second effect results to any appreciable degree only when there is a great variation of the temperature between the inside and the outside of the structure such as might be brought about when the tank is used for the storage of hot liquids, and under such conditions it may become of sufficient impor-



FORMS FOR TANK AT BARNUM, MINN.

tance to require attention. For water storage under the usual conditions, the effect of temperature may usually be disregarded.

The Barnum Tank

The Barnum tank was built for the purpose of storing the municipal water supply. The fact that a hill higher than any platted portion of the village was available led to the adoption of a concrete reservoir for this purpose, set directly on the ground, although it might have been possible to build an elevated tank at a distance of some 700 ft. nearer the center of distribution. The tank is of approximately 75,000 gals. capacity, is 20 ft. in internal diameter and 30 ft. high. The sidewalls are 7½ in. thick except at the point where the turnbuckles occur. At this point it is necessary to reduce the thickness to 6 ins. Excavation for the bottom was made to about 5 ft. below the ground surface, at which point a very solid earth foundation was obtained. The footing for the sidewalls was first built and thereupon the 15 in. reinforced bottom was constructed with its edges resting on the footings. The remainder of this bottom was, of course, supported by the ground. The sidewalls were next constructed by means of sectional forms about 6 ft. high. These were so arranged that both the inner and outer forms could be loosened in sections and then all the forms raised simultaneously by means of a single cable running to a winch placed on the floor inside of the tank. This single cable was attached near the top of the scaffolding to other cables, each of which passed over a sheave mounted on the top of the scaffolding, there being one of these cables for each section of the forms. While being raised, all the forms moved together but hung free from the concrete surface so as not to damage the fresh concrete. The several rings were poured on successive days excepting that one day intervened between the pouring of the lower ring and the second one. The joints between the successive lifts were cleaned and washed before the next day's run was started and the first 6 ins. of concrete poured for each ring was a mixture of one part cement and two parts sand without any stone; ⅝ in. round vertical rods spaced about 5 ft. apart and ½ in. round horizontal rods spaced about 2 ft. apart were placed in the walls. These were merely as a precaution against damage to the structure during construction.

The excavation was started on Sept. 30, 1922. The footings were poured on Oct. 5th using 1:2:4 gravel concrete, the gravel being of a size up to ⅝ in. The floor was poured on Oct. 9th with the same mixture and the building of the interior and exterior scaffolds and forms was immediately begun. On October 22nd, the bottom ring of the tank wall was poured, using a 1:2:4 crushed stone concrete, the stone being from ¼ in. to 1 in. in size. October 23rd was spent in raising the forms ready for the second ring which was poured on October 24th. It had been found by this time that in order to obtain a denser appearing surface, it would be advisable to cut down the amount of crushed stone in the mixture and the remainder of the tank wall was therefore built with a 1:2:3 crushed stone concrete. The pouring of the sidewalls was completed on Oct. 28th, and on Oct. 30th, the first outside reinforcing rods were placed around the tank and tightened just enough to hold them in place.

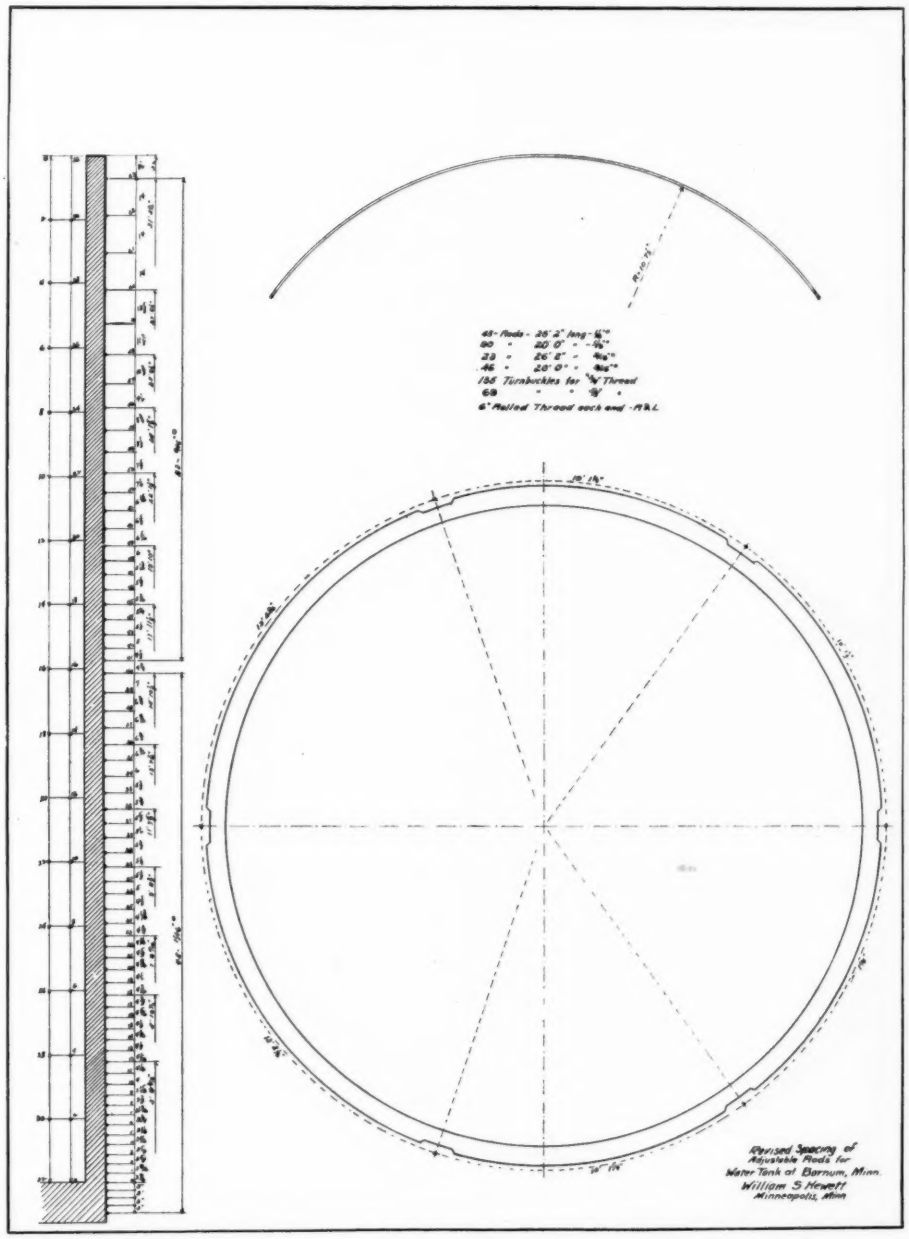
On November 2nd the work of adjusting the rods to the required initial tension was begun and the 18th rod from the bottom was used as a control rod on which the strain gauge measurements were made with a Berry extensometer. The rods in the lower part of the tank were 11/16 in. round and those in the upper portion were 9/16 in. round, all mild steel with an elastic limit of 36,000 lbs. and a modulus of about 25,000,000. They came in three sections with turnbuckles between the sections. Strain gauge readings were taken on this 18th or control rod after it had been tightened just enough to keep it in place. The readings were taken at 10 different points around the circumference of the tank.

The rod was then tightened by men stationed at each turnbuckle while at the same time men with hammers were continually tapping the rod in order to help to obtain a firm bearing against the concrete and to eliminate as far as possible an unequal tension of the rod due to the friction against the concrete. During this process readings were taken on the strain gauge to determine when the rod had been sufficiently tensioned.

The plans originally called for a 12,000 lb. initial stress but it was determined to increase this to between 14,000 and 15,000 lbs. Consequently, when this amount, approximately, had been reached, tightening was discontinued. On Novem-

ber 3rd, all the rods from the bottom of the tank to a short distance above the control rod were tightened as before, men being stationed at each turnbuckle and others tapping the rods.

The men at the turnbuckles all weighed about 175 lbs. and each was given the same 15 in. wrench used on the control rod and instructed to tighten the turnbuckles to as nearly the same extent as he had done in tightening rod No. 18. A third reading was then taken on the test rod and as expected this was shown to have loosened considerably due to the compression now placed in the concrete. It was then again tightened to approxi-



REVISED SPACING FOR ADJUSTABLE RODS FOR WATER TANK AT BARNUM, MINN.

mately the required stress and it was here found that, in fact, the men by using their full weight steadily applied to the 15 in. wrench could judge very closely when the proper tension had been reached.

Before the work was begun, it was hoped that this would be the case, and that it would therefore be unnecessary to take actual gauge measurements on each rod which would have been a very tedious procedure. It was proved beyond a doubt that even inexperienced men of proper weight and given the proper size of wrench can obtain the desired results closely enough for all practical purposes. Simple calculations show that even a 50 per cent variation in the initial stress would not endanger the structure.

The filling of the tank with water was then immediately begun while, at the same time, the remainder of the rods up to the top of the tank were tightened. The 58th rod from the bottom, a 9/16 in. rod, was used as a control for the rods of this size.

We found that a 12 in. wrench was slightly too long for this size rod, but there being no smaller wrenches available, the men were allowed to practice on the test rod and then tighten the remainder. It was found that here too, although in this case they did not have to apply their full weight, they could safely judge when the required tightening had been attained.

On November 3rd, the tank was filled and when the water had reached a level of about 6 ft. from the bottom, two concentrated leaks were discovered at the point where the sidewalls rest on the footings. These were due entirely to pockets of coarse material. Some trouble having been experienced with the pump which was furnishing the water for filling the tank from a nearby lake, only 9 ft. of water had been admitted by November 5th, at which time, in addition to the same original leaks, no others were found, although the footing had become damp around the entire tank. Two small damp spots were also observed in the face of the bottom ring. These spots were perhaps 18 ins. in diameter. A trickling leak was found in the joint between the bottom ring and the second ring where the concrete itself was honeycombed due to insufficient fine aggregate and there was dampness in several other places at this joint.

The bottom ring, as I have stated, was poured with a greater proportion of coarse aggregate than the succeeding rings and besides this, the precaution afterwards used, of beginning each ring with 6 ins. of sand and cement was not employed in this first joint. To these facts must be attributed the damp spots in the lower ring and this joint. The tank was then emptied and a brush coat of metallic waterproofing and cement was applied to the inside of the lower ring and 3 ft. up on the second ring, that is, to the total height of 9 ft. at which the water had so far stood. This brush coat was immediately covered with a second brush coat of neat cement grout. On November 7th and 8th, the tank was pumped full to within 1 ft. of the top. The leaks at the foundation appeared in the same places as before, but it was thought that their amount had decreased. There were one or two moist spots of very small dimensions in the second ring above the point reached with the waterproofing. The trickling leak in the joint between the first and second rings now showed only a slight amount of dampness. The two spots which before had been damp in the lower ring were now entirely dry. Not the slightest trace of moisture showed up in the other joints or rings. On November 8th, final readings were taken on the control rods to see how they were behaving and these readings showed an increase in the tension over that originally given them of roughly between 2000 to 3000 lbs. The complete record of readings on Rod No. 18 is shown in Table I.

At the time the contract for this tank was let, it was not known from what locality the successful bidder would wish to obtain his supply of concrete aggregates, although it was known that locally none was available. Realizing that in case the aggregates finally selected happened to be well graded, it might be possible that the resulting concrete would be a dense and water-tight mixture and that hence, there was a possibility that the waterproofing of the interior of the tank might not become necessary, the specifications were so drawn that such waterproofing was not included in the lump sum bid for the tank.

The provision was made that if waterproofing appeared to be necessary, owing to the nature of the aggregates used, it was to be done for a certain additional

TABLE I—COMPLETE RECORD OF READINGS ON ROD NO. 18

Rod 18, 11/16 in., Area 0.3712. Area of concrete 33 sq. in. E's equals 25,000,000

Points	Gauge Reading, Rod Slack	Gauge Reading, Rod Tightened, Tank Empty	Diff. or Strain Corrected by K equals plus 3	Initial Stress Lbs. per Square inch	Gauge Reading Tank Filled	Diff. or Strain Corrected by Plus 6	Additional Stres, per Square inch Due to Water Load	Total Stress per Square inch Tank filled
A*								
B								
C								
D*	770	1020	253	15812	1050	36	2250	18062
E*	425	560	138	(8625)	640	86	5375	14000
F	575	780	208	13000	810	36	2250	15250
G*	510	710	203	12688	760	56	3500	16188
H*	040	310	273	17062	350	46	2875	19937
I	250	425	178	11125	455	36	2250	13375
J*	320	600	283	17687	640	46	2875	20562
				(Ave. 13700)				(Ave. 16750)
				Ave. 14600				Ave. 17230

Readings adjacent to turnbuckles marked thus: *

Averages in parentheses include reading at point "E," which is evidently in error.

Where rods did not fit the concrete nicely at the start the readings were not satisfactory because they recorded the bending of the rod, in shaping itself to the concrete. Readings at points A, B and C were abandoned for this reason.

sum. Now the experience we had had with the lower ring owing to the rather coarse sand available made it appear the part of wisdom at this point to waterproof the entire reservoir. Therefore the tank was drained on November 9th and the receding water was closely followed by workmen who applied a brush coating of metallic waterproofing and cement to the wet walls. The next day this coat was followed by a second brush coat of neat cement grout. On November 11th we again started filling the tank. Something again went wrong with the pump so that by November 13th, only about 6 ft. of water had been pumped in.

At this time, the leaks around the footings had not entirely stopped but the two original places noted above were now dripping water slowly. The inside fillet designed to shut off any such seepage had not yet been placed. Not the least moisture appeared in the bottom ring or in the joint between the bottom and the second ring.

The season was now well advanced. Unfavorable and severely cold weather could momentarily be expected. For this reason we wished to avoid the delay that would have attended a refilling of the tank to observe at this stage the effect of the waterproofing and therefore dispensed with this and instead immediately commenced work of putting on the outside coating of the tank. The good condition of the lower ring and of the joint between it and the second ring, considered the critical places, allowed the assumption that the waterproof had effectively stopped all moisture everywhere excepting the two slight leaks at the footings.

The tank was drained and the same forms which had before been used were now employed for pouring the outer 3 in. covering. A No. 30 wire mesh was securely fastened to the entire surface of the walls by means of wires looped around it and the reinforcing hoops. On November 14th, this wire mesh and the first section of the forms were in place and poured. The outside consisted of 1:2:2 gravel concrete, the gravel being the same as used in the footings, namely up to ⅝ in. The remaining rings were poured on successive days and entirely completed on November 19th.

The upper two rings of this outer coat were poured during weather ranging from 10 degrees above zero to freezing and they were covered with blankets under which numerous lanterns were hung. On the 20th of November the fillet inside of the reservoir at the point where the sidewalls join the floor was poured. For this purpose mortar of one part sand and 2½ parts cement and ironite mixed was used.

The work of building the forms for the roof was then immediately started and the roof itself was poured on November 27th, using 1:2:3 crushed stone concrete. This was also done in cold weather, all the materials being heated as before and the fresh concrete thoroughly protected, the thermometer registering below zero the night after pouring the roof. The

roof forms were removed on December 4th and 5th and the tank was again started to be filled on December 5th. It was full on the morning of December 6th and was left in that condition until the afternoon of December 8th at which time not the slightest sign of any leaks appeared anywhere. The weather at this time was cold and dry. The same evening the tank was drained for the winter since the water mains for the Village had not yet been laid.

The tank was built substantially in accordance with the original drawings though the concrete mixtures were changed, as noted, during the progress of the work, and there was a change in the sizes and spacing of the rods. The net area of the reinforcing remained exactly the same, however, as originally planned. The accompanying drawing shows the sizes and spacing of the rods as actually built. By marking off the spacing on a pole and then transferring the marks to the outside of the concrete tank, these rods were quickly and accurately spaced. The turnbuckle recesses were built in three vertical lines.

An interesting feature of the rods was the fact that instead of having their ends upset, the threads were cold rolled. They were furnished by Cowin & Co. of Minneapolis. Tests of sections of these rods and turnbuckles which we made at the laboratory of the University of Minnesota showed the threaded section to be actually stronger than the unthreaded portion of the rods. At the same time that these tests were made, the writer had rods, made of the same steel but with cut threads, tested under the same conditions and in these a fracture occurred in the thread and at a lower unit stress.

The entire construction of the tank, from the breaking of the ground until the final test, took from September 30th until December 8th. The tank stood empty from that time on until late in the spring of 1923, at which time the remainder of the water works system was completed and the tank put into permanent use. This period of idleness during winter and the subsequent subjection of the tank, while empty and dry to warm weather before it was finally placed in commission, constituted a very severe test of the structure. After the tank had been in use for several weeks, an inspection showed five or six damp spots, all of which were at the same places previously mentioned and due, in each case, to a slight porosity of the concrete, particularly at the lower horizontal joint. The water was not freely running from any of these but in most cases, moisture could be rubbed off with the hand. To correct this condition, the areas of the interior of the tank surrounding these spots were again thoroughly gone over with the metallic treatment in November, 1923, and the dampness effectively eliminated. The tank went through the winter of 1923-24 in constant use and an inspection during the summer of 1924, when it was full of water, showed that nowhere did any leakage take place and there was not even the slightest indication of dampness anywhere on the entire shell. The outside of the tank is finished with a coat of white Medusa Cement, presenting a pleasing appearance.

Conclusions

From the building of the Barnum tank, we have learned in practice that the Hewett theory of design is correct with respect to the behavior of the steel and concrete. I do not question that this design will entirely replace the former usual method and has successfully solved the problem of building concrete reservoirs and elevated tanks so as to be 100 per cent waterproof. The application of this complete and rational theory to the design of such a structure permits the development of a field in which progress had really come to a dead stop. In addition, it opens up other possibilities. For example, Mr. Hewett has already constructed and successfully tested under high pressure, concrete pipes 30 in. in diameter with walls less than 2 ins. thick.

Our experience at Barnum prompts me to make the following suggestions relating to future work of this kind. The results obtained by means of the metallic waterproofing, when applied to a tank of this type, permit of the conclusion that rather than to incur the expense of trying to obtain an entirely waterproof concrete, by very careful grading of the aggregates and an extremely rich mixture, I would, in the future, as in the Barnum tank, prefer to use only usual care in the selection of the aggregates and, say, a 1:2:3 concrete, afterwards applying metallic waterproofing over portions or the whole of the interior, as shown to be necessary after the tank has been tested. It is a simple, sure and inexpensive process. The use of so-called slip forms was

not allowed at Barnum and should never be. The inner forms should be loosened as soon as possible after pouring and the forms should be wet beforehand so as to allow them to swell and not put any additional strain on the concrete while it is setting. For the same reason, the concrete should be kept wet during setting, thus minimizing the tendency to shrink. These precautions are easily taken although as has been shown, cracks occurring from their neglect do not particularly matter except from the standpoint of the looks of things during construction.

On the Barnum tank, owing to the small working space between the forms used for pouring the outer shell and the tank itself, it was not possible to obtain very good joints between successive lifts of this 3 in. covering. At these joints the results of washing away of cement by the water of the necessarily wet mixture and of seepage through the joints occurring before the tank was entirely tested and waterproofed, are quite apparent at short range. It would be much preferable to use gunite for the outside covering instead of the method employed at Barnum. In any event the outside cover should not be placed until the tank has been fully tested and waterproofed, in that way avoiding unsightly marks caused by such seepage as may take place during the testing and before the final waterproofing.

The analogy of the wooden tank suggests that in order to cheapen construction, concrete tanks can be built of blocks or vertical concrete sections (staves). The vertical joints, always under compression, may easily be waterproofed. I wish here to relate an interesting occurrence at Barnum. On the morning after the lower inside ring had been poured, the outer form was loosened, the inner one being allowed, as it happened, to remain in place for a short time. Thereupon a single vertical crack about 1/16 in. wide developed for the entire 6 ft. height of this ring. Upon the removal of the inner form, this crack closed up and after the outside rods had been tensioned and water admitted, never gave the slightest indication of any seepage. I was informed that other similar cracks had opened at places in this same bottom ring, but these I did not personally see and after the hoops had been tensioned I certainly was unable to detect them. This, it appears to me, is an indication of the success that may be expected to attend the construction of tanks having vertical joints, such as the block or stave construction just mentioned. No experience has yet been had to indicate how much difficulty might be met in waterproofing the many horizontal joints that would have to be dealt with in using the proposed block construction, but I venture to say that any difficulty from this source can be overcome by the application of a thin and dense coat or several coats of gunite. Here again the smallness of the distortion which takes place in any portion of a tank designed by the Hewett method, when the hydraulic load is applied, is of the utmost importance.

(Editor's Note: The author has prepared a simple mathematical discussion of the calculations involved in this design.)

MAINTENANCE OF CREOSOTE BLOCK PAVEMENTS

By A. D. Carpenter, The Barrett Co., No. 1, 19th Ave., South, Minneapolis, Minn.

The transition from a commonly accepted belief of less than ten years ago, that creosote blocks needed no maintenance, to the present condition when everybody recognizes this need and emphasizes it by the practice of constant maintenance, marks a complete revolution in sentiment in this respect.

Creosote blocks have a habit of suddenly leaving the base and forming a hog's back in the middle of the street or pushing the curbing out of line. This is said, not in detriment to creosote block pavement, which has certainly demonstrated its ability to perform all the functions demanded of a high type pavement, but on the same principle that causes your house to look shabby and decay if not properly painted and repaired, or that causes an individual to look seedy or neglected in a perfectly good suit, which has never been pressed; so, likewise, creosote blocks will show forth their own peculiar characteristics as a sign of neglect. But, as stated above this has become a recognized fact, and it is just as unanimously agreed that water, in some form or another, is the cause of it. Beware of water in any form—if it is liable to get into, between or underneath your creosote block pavement. The way to keep it out is to keep your creosote blocks impregnated, and the joints and limits of your

pavement properly sealed by means of bituminous treatments.

Preparation of the Blocks for Treatment

First of all close up your pavement and don't let any one drive into the freshly sprayed material. It is extremely slippery.

If your pavement is taken in time, that is, before the creosote in the blocks has so far evaporated as to permit too much water penetrating the blocks themselves, or before the pitch in the joints has become disintegrated to the extent of letting water in between or underneath the blocks the only preparation necessary will be to thoroughly clean the pavement before treatment. Such is usually the condition if treatments are begun not later than the fifth year after a pavement is laid. In some instances this ideal condition has existed up to and including the eighth year. Considering the slight cost of the treatment compared to the investment in the pavement itself, it is better to err by treating too soon, than by putting it off too long. In cases, however, where blowups or other breaks have occurred, the defective blocks should be removed and thoroughly cleaned, replacing only such as are in good condition, supplying the place of defective ones with new blocks. The base should be carefully inspected and if defective, repaired; either with concrete or any bituminous mixture in common practice for a black base.

A bituminous cushion composed of a mixture of sand and bituminous material that can be handled cold, should then be spread over the base using such amount as may be necessary to get the tops of the new blocks even with the general cross section of the pavement. The blocks should then be fitted into place, splitting such as may be necessary, and the newly placed blocks properly filled with a suitable bituminous filler. Sunken places where the blocks are not blown up, but which leave an ugly depression, may be taken up and repairs made in the same manner. The joints between the pavement and curb should be carefully examined and unless the pitch here is still in good condition, it is wise to clean out this joint and repour. After the necessary repairs have been made, the pavement is ready for treatment.

The Drier the Better

Preparation for securing the refined tar and sand to be used in treatment should be made well in advance, and every precaution taken to assure a supply of the necessary material to enable one to do the work in hot weather. Far greater efficiency can be obtained when blocks are treated in a perfectly dry condition than when even a little moisture is present. It is, of course, difficult to determine just how soon treatment can be made after a rain. This is largely a matter of judgment and wherever possible experienced opinion should be called in at this point. Generally speaking, the drier the better.

It has always been my contention that the creosote blocks themselves will never wear out regardless of the traffic, and therefore, do not need any protection on the surface. If they can be kept sealed in such a manner as to exclude water, trouble is likewise excluded. The object should be, therefore, to get the refined tar into the blocks and joints, and it should be of such a nature as to penetrate the wood as much as possible and seep down into the joints. In order to do this the material should be of a light nature and preferably applied hot. It should also possess the property of setting up when mixed with sand so as to form a good mastic in the joints. It should, however, not set up too soon, but remain plastic long enough for the joints to become thoroughly filled with the sand mastic under the action of the traffic, which may be turned upon it immediately after treatment.

Treatment is usually applied in two coats and best results may be expected by this method. The first application should be as near as can be estimated the amount that the blocks on the average will absorb when left to stand unmolested for several hours. Where possible, the street should be completely closed off and when the first treatment has entirely dried in, a second should be applied, just sufficient in amount to assure that every block has taken in its maximum possible. If the street can be kept closed for a full day it is all the better.

In some instances three coats have been applied in this manner before the blocks were completely satisfied. As soon as the final application has thoroughly dried in, the street should be sanded, generally using about 1 cu. yd. to 200 to 400 sq. yds. of surface. It is, of course, practically impossible to give all the blocks enough refined tar without having an excess in some places. The sand acts to blot up this excess and is carried along under the wheels of the traffic, becoming

well distributed over the surface of the pavement and forced into the joints as intimated above until they are completely filled.

Ten Years Without a Blow Up

If the blocks are taken in time a treatment of this kind suitably done is generally satisfactory for two years. One of our Minnesota cities presents an example where treatment was begun on the fifth year, followed with another on the seventh year and has now gone three years without a treatment and the full ten years without a blowup. The city already has material on hand for a treatment next year. This is one of the instances where good foresight has proven to be good economy likewise. If, on the other hand, the initial treatment is too long delayed, it may be necessary to follow the succeeding year with the second treatment, which if properly done will likely be suitable for two years more without the third treatment.

St. Paul Cost Figures

The cost of proper treatment for creosote blocks varies rather widely, depending upon conditions, but in any case is an inexpensive treatment. A minimum cost of about 5 cts. per yd. and a maximum cost of 8 cts. should be considered as good practice for a treatment as described above. In some particularly favorable instances the cost may be less than the minimum stated above; as an example, we beg to submit some figures recently furnished by the City of St. Paul covering work done this past summer on Summitt Avenue.

Total Yardage 121,350

	Total	Per Sq. Yd. Cts.
Refined tar at $0.1375 per gal. delivered and spread	$3,176.25	2.617
Sand at $1.50 per cu. yd.	469.35	0.387
Miscellaneous material	6.38	0.005
Labor	689.00	0.568
Total	$4,340.98	3.577

Analysis of the above figures shows that but slightly in excess of ¼-gal. per sq. yd. of refined tar was used. Only this small amount was required due to the fact that the traffic on Summitt Avenue is such that it is very difficult to keep the street closed up long enough to let a greater quantity soak into the blocks. Because of the extreme desirability of keeping the street open to traffic as much of the time as possible, only one application of refined tar was made, and the sand covering was spread over it just as soon as it was at all advisable to do so. This, of course, contributes very materially to the extremely low costs. A cost of double this amount is not an unusual occurrence, particularly if the blocks have gone too long before treatment.

No one can, of course, guarantee to eliminate all blowing up or bulging from creosote block pavement by any kind of treatment, when once this blowing up has started, but experience over the past six years, particularly, has proved that the treatment is effective and well worth while.

The foregoing paper by Mr. Carpenter was presented at the 1925 meeting of the Minnesota Engineers and Surveyors Society.

WHO PAYS FOR THE HIGHWAYS?

By John E. Walker, Former Tax Advisor to U. S. Treasury

Like the poor, the question of highway finance is always with us. The question, however, used to be—Who pays—how, and why? The why has long ago discarded, the how is becoming relatively less important, and we are fast approaching the stage where it is no longer a question of who pays and who doesn't. In other words, all of us are contributing a share toward highway construction and maintenance, regardless of motor vehicle ownership. All of us are receiving proportionate benefits—some greater than others.

The position of the Census Bureau on the value of highway improvements is worth noting. The wealth, debt and taxation studies conducted by this Bureau in 1922 showed a total national wealth of some $320,000,000,000, including about $20,000,000,000 of non-taxable property. Our tremendous investment in improved public highways was not set up as a separate entity value, but instead was taken to be reflected in the increased value of the $156,000,000,000 of real property and improvements. This does not mean that the land lying along the improved highway derives all the benefit from the improvement—but rather that the *urban, as well as rural territory served* by the highway does benefit.

This being true, then all should rightfully pay some portion of these costs.

Consider 1923

How was the highway bill paid last year and the year before, and how will it be paid in 1925?

The Bureau of Public Roads has checked up expenditures for 1923—the

latest year available, though figures for 1924 will soon be available.

Consider first 1923.

The total tax bill of the nation for that year, according to the National Industrial Conference Board was $7,716,000,000. State and local taxes represented 50 per cent of this total which was a decrease from 1921, largely due to Federal reductions.

The hopeful signs, however, are increased attention to local administration and the fact that taxes in relation to national income dropped from 16.7 per cent in 1921 to 11.5 per cent in 1923.

Transportation taxes—levied on steam and electric railroads and on motor vehicles, totalled approximately $868,000,000 in 1923, or 11.2 per cent of the total tax burden.

The value of facilities on which these taxes were laid was approximately $30,000,000,000 or 10 per cent of the total taxable national wealth.

The enormous growth of the road-building business is best illustrated by the fact that highway income from various sources as noted later, in 1904 was but $80,000,000 and in 1923 was $1,039,142,292.

While the peak apparently was reached in 1921 with a total income of $1,150,000,000, the 1923 income is nearly 13 times that of 1904 and is four times that of 1914.

Motor vehicle registration has increased ten times since 1914, while the registration fees and gas taxes alone paid by the vehicles were 25 times greater in 1924 than in 1914.

Highway income in 1923 was $1,039,142,292. In the absence of detailed figures which are unavailable, this assumes county income to be the same as expenditures. Total rural highway *expenditures* for the year 1923 amounted to $992,734,611, including interest and principal payments on highway bonded indebtedness.

The total is about $50,000,000 less than the 1921 total. Indications—from the actual figures available for 1921, 1922, 1923, and estimated expenditures for 1924 and 1925—are that the highway program has stabilized at approximately a billion dollars a year.

One fact must not be overlooked, however, in comparing present large expenditures with those of former years and that is the higher price levels which now prevail.

Forty-five per cent of the 1923 expenditures was handled by the state highway departments—the balance of 55 per cent by county and other local units. This as against a ratio of 40 per cent and 60 per cent respectively in 1921. The increase in the state program is caused by a transfer from county to state supervision rather than an increase in the total program.

State highway revenues are much more varied than those of the county and township which must rely mainly upon bond issues and upon real property taxation. Some tendency is observed, however, toward diversion of registration fees and gasoline taxes from state work to county and local units.

That this may be undesirable is indicated by the fact that recent traffic surveys in California, Maine, Connecticut and elsewhere indicate that from 75 per cent to 80 per cent of the traffic volume flows over the state highway systems, which in general comprise 7 or 8 per cent of the total state mileage. If these taxes are levied for a service given, it then appears that this service is derived from a limited mileage and the compensating revenues should be applied accordingly.

Following these dollars of total highway income back to their sources we find current general property taxes accounting for about 36.4 per cent of them; bonds 32 per cent; motor vehicles 20 per cent; Federal aid 7.2 per cent, and miscellaneous 4.4 per cent. Compared with 1921, this represents a 6 per cent decrease in bonds, a decrease in revenue from miscellaneous sources of 4 per cent, and an increase in motor vehicle revenues for highway purposes of 10 per cent.

Current general property taxes for highway use in 1923 were some $380,000,000, or about 5 per cent of the total tax bill, and 8.5 per cent of the *state and local* tax bill.

An analysis of *state* highway income for the year 1923 shows motor vehicle fees and gasoline taxes contributing 36 per cent; property taxes 26 per cent; bonds 19 per cent; federal aid 15 per cent and miscellaneous 4 per cent.

The 26 per cent derived from current general property taxation includes a transfer from county sources of some $65,000,000 as against a similar transfer in 1921 of but $22,000,000. In other words, without increasing the charge against real property, the taxes collected in the counties have, to an increased extent, been passed on to the state for administration.

Analyzing this statement then as to the shift in burden, we would logically first deduct from the property tax total and total highway figure this additional $43,000,000, which is not an increase in taxation but a shift in administration. This gives a total comparable to the situation in 1921. We then find that in 1923 current property taxes contributed 18 per cent of the total state revenues, bonds 21 per cent; motor vehicles 40 per cent; Federal aid 17 per cent and miscellaneous 4 per cent.

Thus, on a comparative basis, bonds which in 1921 constituted 28 per cent of the state highway income were but 21 per cent of the total in 1923, and property taxes which in 1921 were 22 per cent of the total amounted to 18 per cent in 1923—with the total comparative income in 1923 some $40,000,000 higher than in 1921, exclusive of the $43,000,000 additional transfer from counties. To some extent this appears to be due to the fact that additional motor revenues were available for highway work, though this would not appear to be true in a progressive sense for 1924 and 1925. In other words, there does not seem to be a marked tendency to increase the highway program each year by the additional motor vehicle revenues available, but rather a shading off in total of bonds issued and current general property taxes used for this purpose. Wisconsin, for example, has just enacted a law doing away with the direct tax for highway purposes.

Special motor vehicle taxes levied in 1923 amounted to $396,000,000—the equivalent of 40 per cent of the total highway expenditure and 90 per cent of the entire state highway program. Personal property taxes in addition were estimated at $75,000,000.

Forty-three per cent of these total special taxes reached the state highway work, while 50 per cent in all found its way into Federal aid, state, county, and local rural highway work of all kinds.

It appears that the motor vehicle paid in 1923 in total tax dollars to different tax collection agencies almost the entire cost of the system of highways over which 75 per cent to 80 per cent of its use occurs.

The fact that the motor dollar is not always used for highways but takes the place of some other dollar which does go to highway purposes has caused some uneasiness for fear the motor vehicle was not paying any substantial part of the road costs.

This situation has arisen in England where motor taxes in 1924 paid 27 per cent of the total bill, according to an article in Modern Transport of May 2, 1925. There the effect of highway costs upon other transport agencies—notably the rail lines is indicated by a rail contribution through taxation of some 4 per cent of the total highway bill. As an offset, it appears that rail haulage of road materials has increased some 60 per cent since 1920 to a total of some 12,000,000 tons in 1924.

A striking parallel exists in the United States, where some $35,000,000 of rail taxes can be traced to highway uses—3.5 per cent of the total highway bill for 1923. More than $400,000,000 in revenues, or twelve times the output in taxes, seems to have returned to the roads in carriage of manufactured motor vehicles, gasoline and road materials. Much could be added by an analysis of raw material carriage—coal alone used by the industry amounting to more than 4,000,000 tons in 1923—and by the new business moved to rail lines over improved highways.

The situation is not as clear as regards the electric lines and waterways.

County and local statistics are available only in a general way. It is apparent, of course, that the major part of their highway income is derived from current property taxation and the issuance of bonds. However, more and more of the automobile registration revenues and gasoline taxes are being diverted to county and local uses; probably about 6 per cent of the county funds in 1923 come from this source. Based on the 1921 percentages it can be assumed that 43 per cent of their income was from bonds; 46 per cent from current general property taxes and some 5 per cent from miscellaneous sources.

Highway expenditures totalled $992,734,611 in 1923, of which the states administered 45 per cent and the counties 55 per cent.

Of the state expenditures amounting to $442,959,556, 64 per cent was spent for construction as against 70 per cent in 1921; 16.7 per cent for maintenance against 18 per cent for 1921; 5 per cent went for administration and engineering; 7.1 per cent for interest and principal payments on highway indebtedness; 4.5 per cent on machinery and equipment; 2.1 per cent on county transfers, right-of-

way purchase traffic control, etc. and 0.3 per cent on miscellaneous.

Data as to a similar division for counties is not available, hence no recapitulation of total expenditures can be presented.

A comparison with 1921 is of value, however, with particular reference to bond interest and principal payments. This was $31,423,629 or 7.1 per cent of total state expenditures for 1923. Payments for the same purpose in 1921 were approximately $19,000,000 or 4.6 per cent of state highway expenditures.

The 1924 Situation

A few facts on the 1924 situation further strengthen preceding data.

Surfaced mileage has increased from 7.14 per cent of the total in 1904 to 15.98 of the total in 1924.

Total estimated rural highway expenditures for 1924 are $990,000,000.

Some 61 per cent of the special motor taxes were available for 1924 highway work, of which the state used 49 per cent, counties 11 per cent and the Federal Government about 1 per cent.

Motor trucks in 1924 constituted 13 per cent of the registration in 29 states and paid 25 per cent of the registration fees.

It thus appears that the highway program has been approximating the same pace for the past four years.

As motor vehicle revenues have increased there has been a tendency to reduce capital outlays—bond issues and general property taxation, either through partial elimination of the direct tax or through reduced appropriations.

Two Popular Bits of Misinformation Disclosed

Other transportation agencies, the rail lines in particular, seem to profit far more from highway construction than they are taxed for proportionately.

Motor trucks are paying approximately twice as much proportionately as passenger cars, so it cannot be charged that they are using the highways free.

Motor vehicles of all kinds are paying in *special* taxes practically the equivalent of the entire cost of the main systems of highways over which 75 per cent to 80 per cent of their use occurs. When one adds the $90,000,000 personal property taxes paid on motor vehicles, the total taxes on motor vehicles in 1924 exceeded the entire officially estimated cost of these systems.

It also appears that highway construction and maintenance is taking only five cents out of each tax dollar—national, state and local, and nine cents out of the state and local tax dollar. A direct relationship between motor taxes paid and highway costs would further reduce this figure materially, since motor tax dollars are replaced by general tax dollars in the highway budget.

With forty-four states now levying gasoline taxes ranging from one to five cents a gallon, in addition to other taxes, and registrations increasing materially, an ample source of revenue for highway purposes seems assured. There is in some instances a tendency to levy these special taxes for general uses, such as schools, fish-hatcheries, etc. and in other ways to divert these funds. While segregation of special funds is of doubtful value, it would certainly seem that one principle which should be observed is that the total of these special levies be more definitely related to that portion of highway costs properly chargeable to the vehicle.

Another pertinent comment is that the states as a whole seem to be assuming more and more of their responsibilities in connection with the state highway system. Tennessee, for example, is just taking over maintenance on practically all of the state system. It appears from many sources that lack of this action has resulted in counties and small units being overburdened to provide and maintain highways most largely used in state-wide movement of persons and commodities. Their chief sources of revenue being bonds and property taxes, an undue burden has in many cases rested against these property owners.

A last thought for consideration is where almost the reverse of this situation obtains. Some states plan to build and maintain the state system almost entirely from motor vehicle revenues, eliminating bonds and taxes as road revenue sources. It may well be asked here—Is the state still meeting its obligation, or only shifting it?

It is apparent, however, that the chief trouble with the highway tax situation where it has been onerous lies with the small units where the money is raised and spent. Once the question of state responsibility is settled, highway tax adjustment is apparently a local issue.

The foregoing address by Mr. Walker was delivered at the recent Midwest Motor Transport Conference held in Chicago.

SOLVING THE CITY TERMINAL PROBLEM

By Will H. Lyford, Vice President and General Counsel, Chicago and Eastern Illinois Railway Company, Chicago, Ill.

The city terminal problem is to determine the quickest and cheapest way to move persons and goods between city homes and places of business, and the station, yard, or pier at which road trains or steamships start or arrive.

As thus defined, the problem in its entirety is too big for intelligent discussion in a single session of this conference. I will, therefore, omit the consideration of so much of the city terminal problem as is incident to the transportation of passengers and transportation by water route, and will confine my discussion to that important part of the problem which is involved in rail transportation of freight, not only the freight which moves in freight cars, but the heavy express and parcel post, which in reality is freight, although in the United States it is carried on passenger, mail, or express trains, and generally is handled at passenger stations.

Only a single paragraph will be devoted to the movement through or around the city, of inter-line carload freight. That feature of the terminal problem has been solved at Chicago, for many years to come, by the use of belt lines which connect all of the railroads with a great clearing yard, through which loaded and empty cars are interchanged. These interchange facilities, if operated under one management, would have ample capacity to take care of double the present volume of through carload traffic, and when outgrown, they undoubtedly will be duplicated by similar facilities further away from the center of the city.

The freight terminal problem begins where the line haul ends; wherever the road locomotive is cut off from the inbound train. The problem ends at the "store door," which is the common designation for the receiving platform or residence of the consignee. For convenience, we will sometimes use the British term "traders" which includes shippers and consignees.

The Terminal Problem Is Difficult Only at Large Cities

There is no difficult terminal problem in small cities or towns. They have been built around the rail station, and the direct movement of freight to and from the station or steam track is accomplished by the traders, using their own vehicles, or the hired team or motor truck, at small cost to the trader and as promptly as he may desire.

In a large city, however, the concentration of industries near the railway terminal has so increased the value of surrounding real estate that new industries have been forced to more distant locations in all parts of the city and its suburbs.

Competition between the railroads gradually has led them to absorb, in one way or another, the cost of moving goods between the main terminal and the large industry, thereby often giving a substantial advantage in cost of transportation, to the trader who has established a large industry in the outskirts of the city, on land which cost him perhaps $500 per acre, over the trader whose industry is located in the center of the city, on land worth a million dollars an acre.

So far as generalization of city terminal problems is possible, they may be divided into two typical classes: Those which arise in cities where there are natural barriers to the free movement of traffic, and those at cities where there are no such natural barriers. New York and St. Louis are the most important cities of the first class, and Chicago is the principal city of the second class.

The Problem at New York

Carload freight at New York usually is moved across the rivers to team tracks or industries, in line cars which are floated across the rivers, or it is moved by lighters between the rail heads and industries along the shores of the rivers, or pier stations maintained by the railroads. In each case, the line carrier absorbs the cost of lighterage or movement by car float, and the cost of maintaining the float yards and pier stations.

Until very recently, nearly all l. c. l. freight has been floated across the Hudson River at New York in box cars and loaded or unloaded at pier stations maintained by the railroads. Line haul rates to and from New York include the receipt and delivery of freight at the pier stations, but the cost of trucking between the pier stations and the store door is borne by the traders.

The streets near the pier stations are congested and teams or trucks hauling railroad freight are subject to long and expensive delays.

During the past two years, the Erie Railroad has employed the United States Trucking Corporation to move l. c. l

freight by truck between the Jersey rail-head of the railroad and several off-track stations, maintained by the trucking company on Manhattan Island. The trucks are ferried across the river. I understand that some of the other roads are following the lead of the Erie in this practice, and in my opinion, all of them ultimately will do so.

The Problem at St. Louis

At St. Louis, for many years, the freight was moved across the river by teams or trucks on ferries, but the construction of three or four bridges, all of which are used by trucks, and two of which are used by railroad trains, has practically eliminated the ferry service. Carload freight generally moves across the river to and from St. Louis by rail, over the bridges, and a very large proportion, probably 90 per cent of all l. c. l. freight is trucked across the bridges.

On l. c. l. freight, the railroads pay the truck company a fixed rate per 100 lbs. for the movement between the rail-head stations at East St. Louis and off-track stations in St. Louis, and such rate includes the service at the off-track station and the maintenance of the station. Each of the off-track stations has one or two platforms, with a driveway on one side of each platform, for the use of the traders and a driveway on the other side, for the exclusive use of the trucking company, which owns the station.

The advantages resulting from the practice at St. Louis are very similar to those accomplished by the Erie Railroad at New York. The cars are released by being unloaded as soon as they arrive; the time required for the trucking of the freight between the rail-head station and the off-track station is less than an hour; and the trader may truck, to and from the off-track station which is nearest to his industry, all of his freight, from or to any of the railroads.

The Problem at Chicago

In Chicago, on the other hand, there are no wide rivers to be crossed. The narrow Chicago River is spanned by so many bridges that it is not an obstruction to the movement of freight across the river. The bend in the river, between Polk and Eighteenth Streets, limits the number of north and south streets east of the river, but that difficulty, we hope, is about to be remedied by straightening the river and opening several additional north and south streets.

All of the railroads terminate within a very small area in the heart of the business district of Chicago, an area less than a mile wide, and about a mile and a half long. Chicago is a city of enormous distances and covers an area of about 205 square miles, being about 22 miles long, north and south, and about 10 miles wide, east and west. The Chicago switching district, within which uniform switching rates and rules are in effect, covers the much larger area of about 385 square miles.

The railroads extend from the small central area, like the sticks of a fan, in every direction, except due east. Industrial centers have grown up along each of these radial lines, and each industry interchanges freight with other industries in every part of the City of Chicago, and in other cities on or beyond the 33 trunk lines of railroads which terminate at Chicago.

By the use of the belt lines and the clearing yard, the movement of carload freight from any railroad to any industry on any other railroad, can be accomplished with reasonable facility.

The serious terminal problem at Chicago involves the movement of l. c. l. freight. Nearly all of the railroads bring such freight to their terminal freight stations, in the downtown area, and receive their outbound l. c. l. freight at the same or adjoining stations. The problem is to transfer inter-line l. c. l. freight between stations and to move other freight between the station and the store-door. About one-half of the volume of l. c. l. freight originating at Chicago, is trucked to the terminal stations, and the cost of trucking is borne by the traders. They are relieved of the trucking costs on the other half of the l. c. l. freight, by the custom which has grown up, through competition between the railroad lines, of absorbing all of the expenses of trap car, lighterage, and tunnel services, which are equivalent to cartage. These absorbed expenses average about two dollars per ton.

A trader whose industry is located on a side track of one road, may load a box car at his industry, with a minimum of 4,000 to 8,000 lbs. of l. c. l. freight for all destinations on or via any railroad, and that car will be switched around the city to the outbound station of the latter road, without cost to the trader. This is called "trap car service." The railroads also use trap cars for the transfer between stations of a substantial part of their through l. c. l. freight.

A freight tunnel extends under nearly all the streets in the downtown district,

and is connected by elevator with the freight floors of the railroad stations; also with several universal off-track stations, maintained by the tunnel company; and with a limited number of stores. The traders who have tunnel connections with their industries are relieved of cartage expenses on their railroad freight, as the tunnel charges are absorbed by the trunk line; and those who use the universal stations of the Tunnel Company, are required to pay only the cost of cartage between the industries and the nearest universal station.

A third avenue for relief from cartage costs is afforded by the Merchants Lighterage Company, which is controlled by a few large traders, and which moves their freight between their industries along the river, and dock stations established by each of the railroads, and the railroad companies absorb the entire cost of the lighterage service, and of the movement of freight between the dock stations and the rail terminal stations.

Unquestionably the trap car, the tunnel and lighterage services relieve the city streets to some extent, but as now operated, at the expense of the railroad companies, these free services to comparatively few traders, are a serious drain on the revenues of the railroads, and constitute a glaring and unjust discrimination in favor of those traders and against the host of average traders, who cannot take advantage of these services, and still are obliged to compete with the fortunate traders who enjoy them. If the recipients of these free services were obliged to pay the actual cost of operating them, the services would be recognized as an economic waste and they would be supplanted by much quicker and cheaper service by motor truck.

Obstacles to the Solution of the Problem

In my judgment, the solution of the terminal problem at Chicago is more difficult than it is at New York or St. Louis, and the principal obstacles to solution at Chicago grow out of the attitude of the railroad managers and of the large traders.

The manager of a New York railroad (other than the New York Central, whose freight terminals are on Manhattan Island), knows that, under present practices, it costs his company approximately $4 per ton to get his l. c. l. freight into a road train for outbound movement, or to handle his l. c. l. inbound freight, from the time the car reaches his rail-head until the freight is delivered to the truck of the consignee at New York. If such manager can be assured of a cost not exceeding $2 per ton, to get rid of his inbound freight, or to have his outbound freight delivered to him, at or back of the rail-head, he will be willing to pay the $2 per ton to the trucking company, which will accomplish this, as thereby he will save half of the present cost to his own company.

In like manner, the railroad manager at St. Louis is willing to pay to the Columbia Terminals Company about $2 per ton for moving his freight to and from his station at East St. Louis, which movement, if accomplished in any other way than by motor truck, would cost him at least $3.50 per ton.

In Chicago, however, the average railroad manager will tell you that he now receives and delivers his l. c. l. freight at his terminal station in Chicago, without any expense whatever for cartage, and that the traders pay all cartage expenses. Therefore, at Chicago, he will hesitate or refuse to bear any part of the expense of the cartage service, for which he willingly would pay at New York or St. Louis. His statement is true as to about one-half of his l. c. l. freight, but he overlooks the amount of trap car, lighterage, and tunnel charges which his road absorbs daily on the other half of its l. c. l. freight. For example, on each car of l. c. l. merchandise which he receives from a large mail-order house, he absorbs about $25, in switching and other actual out-of-pocket expenses, before he begins to perform for that freight the same service which he performs for the freight of the average shipper, which is carted to the terminal station at the shipper's expense.

A second obstacle is the deep-seated objection of the average railroad manager to the adoption of new facilities and practices, which have been proven to be practical and economical, by someone outside of the manager's own organization.

A third obstacle is the fact that different practices often involve substantial expenditures for different facilities, and the railroads, especially since the war, have been handicapped by inadequate revenues and the difficulty of financing the cost of additions and betterments.

A fourth obstacle is the unwillingness of the large shippers, who enjoy the free trap-car, tunnel or lighterage services, to relinquish or pay for them, and thus to be placed upon the same basis on which

their less fortunate competitors are obliged to do business.

A fifth obstacle is the unwillingness of nearly all traders to change their present practices, for the general benefit of better transportation. The average trader will not recognize the fact that poor transportation is expensive to him, at any price, and that, in the long run, even if furnished to him entirely at the cost of someone else, poor transportation would be more expensive to him than good transportation, for which he paid the full cost. The fair trader is willing to pay the reasonable cost of any service rendered for him by any other trader, and I believe that, when the traders realize the situation, they will be willing to pay the reasonable cost of the most important service which they require: good transportation.

Efforts Already Made to Solve the Problem

Solving the city terminal problem frequently has been undertaken by theorists and politicians, but it also has engaged the earnest study of the railroad men who have had the widest experience in the operation of railroad terminals, and, recently, of the ablest public officers and automotive engineers.

New York has its Port of New York Authority, a bi-state commission created by the laws of New York and New Jersey to study and to solve the terminal problem at the Port of New York. That city also is the headquarters of the Society of Terminal Engineers, a nation-wide organization, which devotes its entire attention to terminal problems.

The General Managers' Association of New York, composed of the managers of the railroads which terminate at New York, has a committee of practical terminal experts, who are devoting their time to the terminal problem, and are studying it in a broad way.

Shortly after our country became involved in the Great War, a committee terminal operating officers was organized at Chicago, by the War Board, to solve the terminal problem at Chicago. The functioning of that committee was temporarily interrupted by the Federal control of railroads, but the committee has resumed its activities, and is collecting a vast amount of reliable and useful information as to the movement of traffic in and around Chicago.

At St. Louis, the railroads joined in forming a committee of terminal experts, representing the different railroad lines which reach that city, and they made a comprehensive study of the terminal problem at St. Louis. I understand that the committee made a unanimous report outlining a feasible solution of the problem, but that afterwards the representatives of some of the railroad companies repudiated the report, because it was unsatisfactory to a few large shippers.

Within the last two years Shippers' Advisory Boards have been organized by the traders, in each transportation region of the United States. Their meetings occur frequently and regularly and are participated in by practical traffic and operating officers of transportation lines. They discuss and iron out all sorts of transportation problems, including, necessarily, those which relate to terminals and their operation.

The most comprehensive movement that has ever been undertaken to solve transportation problems was inaugurated by the Chamber of Commerce of the United States, in 1923. The President of the Chamber called to a Transportation Conference, the prominent shippers, the public officers and college professors most interested in transportation, and the leaders in the automotive and railroad industries. Committees were appointed to study and report on each of the principal transportation problems.

The committees devoted about one year to investigation and the preparation of reports. Their reports were submitted and approved at another session of the Transportation Conference, early in 1924. The principal conclusions of the reports later were submitted, by the Chamber of Commerce of the United States, to a referendum vote of its members, and were approved by large majorities.

The conclusions which have been given the widest publicity and the most general public approval were:

(a) That the motor truck should co-operate with the railroads and that such co-operation would be most effective in large terminal areas;

(b) That a well-organized system of store-door delivery of freight by motor truck is the greatest contribution which could be made to the solution of terminal problems;

(c) That organized motor transport could also relieve the railroads of various forms of uneconomical service, such as trap-car service, switching between local stations and short-haul shipments, and would reduce yard congestion and release

many cars for more profitable line haul; and

(d) That, while such organization of motor trucking, in co-operation with the railroads, would give substantial relief to all the railroads and would increase their carrying capacity and reduce their terminal costs, it also would give to the shippers of freight more adequate and prompt transportation, without increasing the aggregate sum of railroad rates and cartage costs which the shippers now pay.

A year later, in January, 1925, the Port of New York Authority published its report, recommending the establishment of off-track zone stations in 13 districts or zones, in the City of New York, and the movement, by motor truck, of l. c. l. freight from the rail-heads in New Jersey, the Bronx, and Long Island, to these zone stations, for delivery to destinations within the zone, and the reverse movement of outbound freight by motor truck, from the zone stations to the rail-head stations.

Universal Zone Stations

In my judgment, based upon more than 30 years of study of terminal problems, at Chicago, New York, St. Louis, and other cities, the best solution of the freight terminal problem at all large cities would be found in the adoption of the principles of this recent report of the Port of New York Authority.

Each city should be divided into zones, the limits of each zone to be determined by the volume of freight which it originates or receives, within a given period.

In each zone a modern freight station should be provided, with inbound and outbound platforms, adequate driveways and approved machinery for handling freight.

Each such zone station should have warehouse and manufacturing floors, above the station floor, and should serve as a common station for all railroads and the principal water lines; at which all shippers and consignees within the zone might deliver and receive, or store, their freight.

The upper floors of such a station would be most attractive and valuable lofts and would warrant exceptionally high rentals.

The movement of l. c. l. freight between the rail stations and the zone stations should be made in large motor truck units, of at least 5 tons capacity, and, for such service, demountable bodies or semi-trailers should be used, in order to avoid the delay of the truck or tractor and the driver, while the freight is being loaded or unloaded.

The efficiency of the demountable body as a container for moving l. c. l. freight has been proven by successful practice at Cincinnati, where a large proportion of the inter-line transfer of l. c. l. freight has been carried on, for several years, by the Cincinnati Motor Terminals Company, under contract with each railroad company. An efficient track-despatching system and electric hoists for the quick movement of the truck body between the station platform and the chassis, enable the trucks to move almost constantly and with clock-like regularity.

The outstanding example of the efficient use of tractors and semi-trailers for the movement of railroad freight, is the operation of the Columbia Terminals Company at St. Louis, which for several years has been moving a large proportion (now probably 80 per cent) of all l. c. l. freight, between the rail-heads at East St. Louis and 8 or 10 off-track stations maintained by the Terminals Company in the City of St. Louis. Where a semi-trailer receives a full load at the station of one railroad, for transfer to the station of another railroad, it is moved directly between the two stations and by-passes the off-track station.

The American Railway Express Company also operates large fleets of tractors and semi-trailers for handling express traffic in large cities. Similar fleets are maintained by a few large traders, in different cities.

Advantages Which Would Result from the Use of Zone Stations

If the recommended zone stations were provided, the railroads would have no need for expensive freight stations at their rail-heads. Covered platforms, perhaps 50 ft. wide, within two or thee miles from the rail-head, with a broad driveway on one side and tracks on the other side, are all that would be required. Inbound freight would be moved directly from the cars to waiting truck bodies, which would be supplied in sufficient number to receive the freight as fast as unloaded from the cars. Outbound freight would likewise move directly from the truck bodies to waiting cars. If demountable bodies were used, the platform would be equipped with proper machinery for moving the bodies between platform and motor chassis.

The other principal advantages which would result from the use of zone stations might be tabulated as follows:

To the City: The reduction of street congestion, by moving railroad freight to and from each district of the city, in large motor truck units, fully loaded, thereby removing from the streets three times as many miscellaneous cartage vehicles.

The removal from the downtown streets of the cartage of all railroad freight which does not originate in, or is not destined to that district.

The ease of creating new industrial centers, by the location of additional zone stations.

To the Railroads: The prompt unloading and reloading of cars at or back of the rail-head.

The speeding up of transportation, by avoiding delays of freight in the railroad terminals.

The actual reduction of terminal expenses.

The elasticity of the system which would enable the railroads to handle, currently, any increase of merchandise traffic, by the multiplication of the zone stations and trucks, without increasing the railroads' investment in their separate terminal facilities.

To the Trader: The current hourly movement of his freight between all the railroad stations and the zone station nearest to his industry.

The opportunity to receive and deliver, at one zone station, near his industry, all of his freight moving over any railroad, and the reduction of his cost of cartage which would result from such consolidation of loads and limitation of cartage distances.

Store-Door Collection and Delivery

The natural evolution of the establishment of universal zone stations in large cities, would be a general demand for store-door collection and delivery.

Whenever a demountable body or semi-trailer received a full load of freight from one railroad, consigned to one trader, both trader and trucking company would see the futility of passing the freight through the zone station, and the trader should be willing to pay to the trucking company, for the direct movement from the railroad to his industry, approximately the cost to him of a similar movement with his own or hired trucks.

Since the publication of the report of the Transportation Conference, more than a year ago, which declared "that a well-organized system of store-door delivery by motor truck would be the greatest contribution to the solution of the terminal problem," a demand has been voiced in all parts of the country for the establishment of such a system in all large cities, and the railroads have been bombarded with requests that they should furnish store-door service, as is done by the railroads in Great Britain and Canada.

In my judgment, not as a railroad official, but as an independent student of transportation, there are many convincing and controlling reasons why the rail carrier should not undertake to furnish store-door delivery in the United States, and why such service should be performed by an outside agency, working in close co-operation with the traders and the rail carriers; the cost of such service to be a separate charge upon the trader, in addition to tariff rates for rail transportation from station to station. This also was the conclusion of the Transportation Conference and the Chamber of Commerce of the United States.

Unquestionably, the greatest efficiency and economy in store-door service could be attained by having the zone stations and the trucking operations controlled by one organization in each city, and representatives of the traders and of each railroad company should have supervision over the management of such organization, in order to insure impartiality in service, as between the railroads and as between the shippers.

The ideal arrangement would be to have all such local organizations co-ordinated in one national organization, so that complete transportation of l. c. l. freight, between any two industries in the United States, could be furnished by a single organization under a single contract, which would cover the rail transportation and the cartage at both ends of the line movement.

There are almost innumerable freight-forwarding companies in the United States, which contract to furnish such complete transportation of selected freight, between a limited number of cities. In most cases, such forwarding companies consolidate their shipments into car-loads, which move at carload rates between the cities, and are loaded or unloaded at each end of the route by the forwarding company or its agency. Probably the consolidation of all such forwarding companies into one national organization would be impractical, and I can see no good reason why they should not continue to operate separately and in

competition with a national organization, especially if they will use the railroads only for carload shipments, and will keep the freight out of the terminal freight stations of the railroad companies, loading and unloading it on public team tracks or private sidings.

The ideal plan which I have recommended, is identical with the plan of operations of the American Railway Express Company, and that company has been urged to enlarge its field of operations and to include therein not only the freight which now moves as express, in passenger and express trains, but also all classes of l. c. l. freight, which moves in freight trains.

The Express Company has made an elaborate study of this problem, but as all of its present traffic is moved under uniform contracts with the rail carriers, I understand that it feels that it should not undertake l. c. l. freight service, without contract guaranties from all the railroads, and I doubt the possibility of obtaining such guaranties.

It seems to be conceded generally that store-door collection and delivery of railroad freight must be a voluntary service, tot be accepted or rejected by the traders. The only reasonable exception to the voluntary feature, seems to be the one in force in Great Britain, that the trader who does accept store-door delivery must accept it for a given time for all of his freight, and that he cannot elect to do his own carting when the weather is good, or when his team or trucks are available, and at other times demand store-door service.

My paper already is too long to permit me to enlarge on the impetus which would be given to store-door service by providing, in large downtown industrial buildings, ample common facilities for the shipment and receipt of freight for all occupants of the building.

There is a wide difference of opinion as to the necessity for zone stations in connection with store-door collection and delivery. In my judgment, the greatest possible economies in trucking railroad freight to and from the store-door cannot be attained without the use of zone stations. No single railroad company has enough freight, moving to and from individual traders in each district of a large city, to assure full truck loads for the long haul, and the greatest economy comes from mass movement over long distances. Even if a truck should have a full load from one railroad to one trader, it would not often have a full load from the same trader for the return trip. A near-by zone station would furnish the full return load. Smaller trucks would move the freight between the zone station and the store door. The largest merchandising firms in our large cities use this system for the distribution of their goods throughout the city and suburbs. They have found that the zone station is absolutely necessary for economical delivery service over a wide territory.

Advantages to the Railroads of Store-Door Collection and Delivery

Undoubtedly, the railroads would welcome store-door delivery of all l. c. l. freight, by an organization of traders and at the expense of the traders, as it would free their stations of storage freight, awaiting delivery, and would enable them to pass through their stations an unlimited volume of freight, as is the case in Great Britain. Although the freight traffic in Great Britain has increased from year to year, the railroads hardly ever have been obliged to enlarge their freight stations in London or other large cities. There is practically no limit to the amount of freight which can be passed through a freight station, if always there are standing on one side of the platform, a sufficient number of trucks to receive all of the freight as fast as it is unloaded from the railroad cars, thus avoiding the necessity for flooring the freight on the platform.

Another great advantage to our railroads which would result from store-door service would be the possibility, already mentioned, of moving their terminal stations to locations outside of the congested business districts of cities. So long as the trader would pay a flat rate for the cartage of his freight to or from any railroad, it would be immaterial to him where the rail stations were located. With adequate street capacity for the movement of trucks, the increase of two or three miles in the trucking distance adds very little to the cost of motor trucking.

Advantages to the Traders of Store-Door Delivery

There are two outstanding facts which indicate that distinct advantages to the trader would result from store-door collection and delivery, and that those facts are recognized by large numbers of traders.

One. In Great Britain, where the Federation of British Industries has as great

an influence with the public regulatory bodies as is possessed by the National Industrial Traffic League, in the United States, voluntary store-door delivery is provided for by law and is accepted by a very large proportion (from 80 to 95 per cent) of the traders. The concensus of opinion of the large traders and the railroad officers, in Great Britain, is that they could not possibly carry on their present volume of business, without the store-door service. It has received similar approval in the large cities of Canada.

In England, Scotland and Wales, the store-door service, supplementing their "goods trains," which we would call freight trains, furnishes such prompt transportation, that what we call heavy express and heavy parcel post is unknown in those countries. The railroads are exempt by law from any obligation to carry any goods, except perishables, on passenger trains. They do furnish a package service on some passenger trains, for packages which require especially quick service, but they discourage such package service on passenger trains, by fixing rates so high that the service will not be availed of, except in cases of emergency. Parcel post service in Great Britain is limited to the international maximum weight of 11 lbs. per package.

Two. The volume of express and parcel post traffic in the United States has grown, in percentage, much faster than the volume of l. c. l. freight traffic. Inquiry from many sources brings the answer that the reason is that, for any destination, the shipper may deliver his express shipment to the Express Company at his store door, or may deliver his parcel post package at the nearest sub-postal station, and feel reasonably sure, in either case, that the shipment will be delivered to the consignee, without any cost to the shipper or consignee other than the single rate which is paid to the Express Company or the postmaster. In contrast, the shipper of l. c. l. freight must arrange for its cartage to the initial railroad, and either he or the consignee must arrange for cartage delivery at destination, and if the shipment passes over several railway lines, he may have difficulty in tracing for delayed or lost freight and in collecting claims.

Consolidation of Parcel Post, Express and L. C. L. Freight for Movement by Rail

I am a firm believer in the seemingly radical proposition that more regular and economical transportation of l. c. l. freight, express, and parcel post (exclusive of small and valuable packages which ought to continue to be carried on passenger, mail or express trains), would result, in the United States as it does in Great Britain, from consolidating the railroad transportation of all three of these classes of traffic and moving them in the same cars, between the freight stations of the railroads, with prompt and adequate cartage service at each end of the line.

At any outbound terminal freight station there are always standing at the platform throughout the day a sufficient number of cars to carry the anticipated traffic of the day, to all destinations. All l. c. l. freight delivered at the station during the day is loaded into such cars and started on its way in the early evening. The convenience to the post office department or the Express Company, of being able to make deliveries to the station at any time during the day, as compared with the inconvenience of meeting the scheduled time of departure or arrival of a half dozen or more passenger trains, is apparent.

The consolidation of these three classes of traffic in the same cars would be advantageous to the railroad, as it is well known that the average lading of an l. c. l. freight car of 40 or 50 tons capacity is from 4 to 6 tons, and the addition of the mail and express traffic, which in volume amounts to about one-seventh of the volume of l. c. l. freight, would make no appreciable increase in the cost of moving the freight car.

The only physical difficulty in carrying out this scheme lies in the fact that the inbound freight stations of railroad companies generally are congested with freight awaiting delivery at the convenience of the consignee. This difficulty would be solved by the adoption of a common delivery service. This is proven by the practice in British terminal stations, where the freight is loaded on highway trucks, as fast as it is removed from the rail cars, and the station platforms are kept so clear of freight that the same platforms are used during 24 hours for three separate and distinct classes of traffic, inbound merchandise during the forenoon, outbound merchandise during the afternoon, and fish and vegetable traffic between midnight and morning.

With our inbound stations cleared of

freight awaiting delivery, there would be sufficient room in the stations to accommodate all of the express and parcel post traffic and, in most cases, to set aside space for the exclusive use of the Post Office Department, as sub-stations for rehandling certain parcel post which otherwise must be carted to the general post office before being distributed to the substations. These additional facilities would be of very great benefit to the Post Office Department, as nearly all central post office buildings were built without consideration of the requirements of heavy parcel post packages. Those buildings already are badly congested and there is a constant demand for larger post office buildings in the centers of the principal cities.

The City Terminal Problem Must Be Solved

The city terminal problem must be solved, if the efficiency of our matchless railroad system is to continue. Present railroad revenues are inadequate to absorb present railroad terminal expenses and leave sufficient net income to sustain the credit of the railroads and to enable them to finance the additions and betterments which are necessary to maintain their present efficient service, with the ever-increasing volume of traffic. Either the railroads must enlarge their terminal facilities, or practices must be adopted which will enable them to pass more traffic through their existing facilities.

I do not advocate the adoption of untried experiments. There is no feature of the terminal problem which has not been solved somewhere in the United States or Great Britain. It is not necessary to create new solutions, but only to collate proven solutions and to adopt them.

Even the seemingly overwhelming problem of distribution of cost of terminal operations has been solved in Great Britain, by establishing separate rates to cover line haul and terminal service, so that the terminal cost is paid only by the trader who enjoys the terminal service.

In the United States the trader who ships goods locally between small cities and towns is obliged to pay freight rates which are weighted with part of the cost of terminal operations in the large cities, which are not involved in the shipment of those goods.

Assistance From the Government

While I believe that the proposed consolidation of all the railroads into a few large systems will facilitate the adoption of improved practices, by reducing the number of chief executives of railroads who will have to be persuaded of their feasibility, and that the Shippers' Advisory Boards also will be helpful, I fear that only the exercise of the power of the Interstate Commerce Commission and the State Public Utility Commissions will be able to overcome the obstructions I have mentioned. That power will not be invoked by the railroads or by the preferred big traders. In my judgment it will be invoked only when the great army of small and average traders combine and demand that all discriminations between them and the powerful big traders be abolished, and that the small or average trader be charged only with the reasonable cost and a reasonable profit on the service which he actually uses.

Section 3 of the Interstate Commerce Act provides:

"That it shall be unlawful for any common carrier subject to the provisions of this Act to make or give any undue or unreasonable preference or advantage to any particular person, company, firm, corporation, or locality, or any particular description of traffic, in any respect whatsoever, or to subject any particular person, company, firm, corporation, or locality, or any particular description of traffic, to any undue or unreasonable prejudice or disadvantage in any respect whatsoever."

Section 15 of the same Act authorizes the Commission, upon complaint, or after full hearing under an order for investigation and hearing made by the Commission on its own initiative, to determine what regulations or practices are unjustly discriminatory or unduly preferential or prejudicial, and to make an order that the carriers cease and desist from such regulations or practices. The States which have commissions for the regulation of railroads have adopted similar laws, as to intra-state traffic.

It is difficult to understand why the traders, who are suffering from the competition of the recipients of preferential advantages, do not take the necessary steps to bring these conditions to the attention of the commissions, and to the knowledge of the general public, and insist upon the relief to which they are entitled, under the law.

Tribute to the Leaders of the Automotive Industry

I realize that the foregoing is a very sketchy discussion of the city terminal problem, the efforts which are being made to solve it and the difficulties involved in its solution. This paper already is far too long but I am unwilling to close it without a tribute to the great leaders in the automotive industry who have developed the motor truck, which makes possible the solution of the city terminal problem. Those leaders are banded together in the National Automobile Chamber of Commerce, under whose auspices this conference is being held. Besides developing a marvelously useful machine, they are also doing valiant work in educating the public to a full realization of the possibilities of co-operation between the motor truck and the railroads, and of the better transportation which would result from such co-operation. The spirit which actuates them is well shown by an episode in my own experience:

About three years ago, when I had satisfied myself that the motor truck was the answer to the greatest problem in railroad transportation—the city terminal problem—I sought the advice of the man who is now President of the General Motors Corporation, on the question as to whether it would be better to have the railroads, or someone outside of the railroad organizations, launch a campaign to bring about co-operation between the railroad and motor truck, and ultimately to establish storedoor collection and delivery service. The interview occurred in the fall of 1922, when railroad service, to say the least, was inadequate. His reply is the significant part of the story. He said:

"Mr. Lyford, I suppose you have come to me because I am an officer of a corporation which is interested in the manufacture and sale of G. M. C. trucks. I am deeply interested in your subject, not from the standpoint of a manufacturer and salesman of motor trucks, but from the standpoint of a large shipper by rail. The manufacture and sale of motor trucks is of comparatively small importance to our company, as our principal business is in the field of the passenger car. The entire business of the companies controlled by the General Motors Corporation is limited and restricted by the inadequacy of rail transportation. We are handicapped by the inability of the railroads to bring materials and supplies to our manufacturing plants and to deliver our finished product. Anything on earth that will help to produce better transportation by rail will have our hearty support."

That Mr. Sloan voiced the views of his company is proven by that fact that its Vice-President, Mr. Swayne, was the active and efficient Chairman of Committee IV of the great Transportation Conference; and by the further fact that the General Motors Corporation has placed at the disposal of the railroads the man who knows more about the subject of storedoor delivery than any other man in America, Mr. F. C. Horner, who devoted eighteen months to the study of store-door service in the British Isles. Mr. Horner and a staff of expert motor transportation men are serving the railroads by making investigations of the conditions and requirements of freight terminal service of each railroad in the large cities, without any expense to the railroads and with the purpose of helping them to solve their terminal problems.

Mr. Walter C. White, the head of the White Company, has been equally helpful to the railroads. He made it possible to prove out the efficiency of the demountable body in railroad service at Cincinnati, and furnished the financial backing for Mr. B. F. Fitch, who has devoted the past ten years to the study of the terminal problem at New York, Philadelphia and other cities, and has freely given to the railroads the benefit of his investigations and conclusions.

Mr. Brosseau, the President of Mack Trucks, as an officer of the Chamber of Commerce of the United States and of the National Automobile Chamber of Commerce, and individually, has been an active promoter of a better understanding between the automotive industry and the railroads. He was an untiring participant in the work of the great Transportation Conference.

With the men I have mentioned I am personally acquainted, but I know that there are many other leaders in the automotive industry who liberally have contributed their time and money to the cause of better railroad transportation.

Conclusion

I will not admit that the automotive industry is directed by wiser or abler men than those who control and operate our railroads. The marvelous progress of

the automotive industry during the past ten years, as compared with the progress of the railroads, is not due to the difference in personnel, but to the difference in the financial conditions of the two industries. The automotive industry, being comparatively free from government restraint, has been able to fix its own prices and wage scales, and to earn so large profits that it could devote enormous sums to research and experimentation. The railroads, on the other hand, were thrown into chaos by Federal control, and have been so restricted by the government control of rates and wages, that their revenues have not been sufficient to pay their operating expenses and taxes, and to leave a reasonable return on their investment. Therefore, the railroads have had no money or credit to use in research or experimenting.

The Pennsylvania and New York Central, and the Erie and Boston and Maine railroads, are notable exceptions in the railroad world. President Rea of the Pennsylvania and the late President Smith, and his successor, Mr. Crowley, of the New York Central, have had the money to spend, and have spent it freely and wisely, to prove that the use of motor trucks, instead of freight cars, for short movements of l. c. l. freight, would result in better transportation. The Erie and the Boston & Maine had had no money to spend, but Mr. Powell of the Erie and Mr. Gerrit Fort of the Boston & Maine, are actively developing the use of motor trucks in connection with their rail services. Already these four companies have accomplished substantial results, and I believe that, with proper cooperation from the traders, the government bodies and the automotive industry, they will establish precedents which, within a comparatively short time, will solve the city terminal problem.

The foregoing paper by Mr. Lyford was read at the recent Midwest Motor Transport Conference held in Chicago, in May, 1925.

CONTINUOUS SLUDGE REMOVAL AT KANSAS CITY WATER PLANT

Substantial savings in operating costs are expected to be realized in the new Kansas City, Missouri, water treatment plant, by embodying the feature of continuous sludge removal in the pre-sedimentation units.

Four 200-ft. Dorr Clarifiers will be installed and these are designed to give the capacity flow of 100,000,000 gals. per day a detention period of three hours, and to remove continuously from 80 to 90 per cent of the suspended matter from the raw Missouri River water.

Although 200-ft. Dorr machines are in successful operation in the field of mining, the largest previous installation in water treatment plants was an 85-ft. unit. The Kansas City clarifiers will be of the peripheral drive type, and the settled sludge will be returned continuously to the river.

The plant was designed by Fuller and Maitland, and the James Black Masonry and Contracting Company, has been awarded the contract.

CONCRETE ROAD CONSTRUCTION IN MISSOURI

(Editor's Note: Following is the procedure in concrete road construction in Missouri as prepared for the Missouri State Highway Department short course for all employes by B. H. Piepmeier, Chief Engineer.)

The first Portland cement concrete pavement of which there is reliable record, was constructed in 1893. Prior to 1909 concrete pavements were regarded as experimental. The majority of concrete pavements that have been constructed to date have proven to be satisfactory. Concrete is a type of road admirably adapted to meet the needs of present-day traffic. Its advantages are durability, smoothness of surface with little resistance to traffic, low maintenance cost, freedom from dust and slipperiness, and it will serve as a base for some other type of surface when resurfacing becomes necessary. The principal disadvantages are that it is noisy under horse-drawn traffic, it cracks badly, which necessitates frequent attention, and its sharp line of separation between the concrete and the earth shoulder, which adds some maintenance expense.

The success of a concrete pavement depends upon the quality of the materials that enter into it, and the efficiency of workmanship during construction.

The outstanding and fundamental requirements of successful concrete road construction are:

Drainage of roadbed.
Uniformity of subgrade.
Uniformity in the quality and grading of aggregates.
Accurate proportioning of aggregates and cement.
Time of mixing.
Consistency of the mixed concrete.
Finished surface.
Curing of surface and sides of slab.
Protection from traffic during curing.

Preparation of Subgrade

The essential qualities of the subgrade are, uniformity of cross-section and density. The preparation of the subgrade is a simple matter if the rough grading has been properly done. The subgrade includes the surface upon which the slab is to be laid and at least 18 ins. outside for the foundation of the forms. The subgrade must be lightly rolled to secure uniformity and smoothness. Clay soils, compressed by rolling, swell considerably when moistened. Uneven swelling caused by over compaction will offset any advantage gained by heavy rolling. Light rolling with a 5-ton tandem roller is to be preferred. Spongy or yielding spots that develop should be removed and the hole filled with acceptable material.

Drainage conditions should be as near perfect as is possible. Tests have shown that the subgrade under all pavements is usually in a saturated condition, but excess water is undesirable.

When preparing the subgrade it should be bladed down to its approximate surface elevation before the forms are set. Fine grading should be done by hand or by the use of a subgrade machine after the forms are set. The cross section must always be carefully checked by a template to insure full depth and proper section. Low places may be filled with earth and rolled with a light roller or be hand tamped, but this practice should be discouraged. If the subgrade is built properly ahead of the concrete, it will need but little attention. The template used in constructing the subgrade must be checked with the one on the finishing machine to see that the full section of the slab is secured, consideration being made for the shrinkage of the concrete and the settling of the side forms between time of placing the concrete and its setting. The subgrade must be prepared at least 500 ft. ahead of the mixer to insure uniformity and to avoid delays. The subgrade should be saturated with water several hours ahead of the placing of the concrete to prevent absorption of water from the slab, and so that it will get its swell before the final check and placing of the concrete. It should not be sprinkled ahead of the mixer unless it is very dry and dusty. The subgrade must always be checked as to the cross section just before depositing the concrete.

Setting Forms

Forms set true to line and grade and on a firm foundation help to insure a smooth riding surface. Engineering stakes to guide the setting of forms should be driven to grade at 50-ft. intervals on tangents and 25-ft. intervals on curves. The forms should be of heavy metal, and of a depth equal to the full thickness of the concrete at the edges. On insecure subgrade they may be supported on planks or on stakes driven to firm bearing. Joints should be staggered where possible instead of opposite each other. All steel forms should be oiled ahead of placing the concrete to prevent it from sticking. The use of bent forms should never be allowed. Uneven forms will disturb the proper action of subgraders and finishing machines and this will result in an improper thickness of the concrete slab or the finishing of the wearing surface, hence all forms should be carefully watched during the course of construction. The quality of the surface depends to a large extent upon the trueness and stability of the forms.

Materials

All materials entering into construction must be inspected and approved before being used. Notice of such approval is indicated by a card attached to the car by an inspector at the producing plant or by postcard mailed by the inspector to the party receiving the material. If project engineers find materials that are unsatisfactory they should reject them for use, even though accepted at point of origin, and notify the engineer of tests at once. No cement must be used until the results of the 24-hour test have been received.

The storage of materials is important. Stone and gravel should be stock-piled in layers instead of in conical piles, to prevent segregation. The place of storage for aggregates should be carefully chosen to prevent waste in clearing up. Sometimes it is economical to plank the storage space. Cement sheds must be constructed so as to be weatherproof, with the floor high enough to exclude ground

moisture. All cement that has a tendency to cake must be screened and resacked by weight, before using. Cement in storage over winter months must be retested before using.

Proportioning Aggregates

The quantities of materials entering into concrete must be accurately determined before they are placed into the mixer. The grading of the aggregates together with the specified proportions are designed to give maximum strength to the pavement. A variation from these proportions is likely to weaken the slab. Keep in mind that moist sand has a much greater volume than dry sand. The sand may vary in volume as much as 20 per cent, depending upon the moisture content. The proportions specified are on the basis of all materials being measured dry. Inspectors must have measuring boxes on the job and check accurately the capacity of all measuring devices. Unless there are measuring hoppers on storage bins, all materials dumped into truck bodies or batch boxes must be struck off to insure accuracy. Barber-Greene loaders, or other devices using irregular shaped hoppers must be watched continuously to get accurate proportioning. In picking up materials from stock piles, especially with loading devices, care must be exercised to prevent segregation of aggregates. Inspectors must also watch clam shells or mechanical loaders while taking aggregates off the ground to see that they do not dig up the earth and incorporate it with the aggregates.

Water Supply

The water supply is an important factor in concrete construction both in quantity and quality. Where the quality is questionable, especially around mining districts, analysis should be made before using. The amount of water needed varies with the moisture content of the aggregates, the porosity of the stone, and the method of curing employed.

Mixing and Finishing

The concrete must be mixed in a machine of the boom and bucket type. Chute delivery of the concrete from the mixer is not satisfactory as the tendency is to mix the concrete too wet so that it will flow easily. The chute also tends to windrow the concrete by depositing the coarser particles separate from the mortar. Concrete must be mixed thoroughly and to a uniform consistency. The time of mixing must be long enough to secure the maximum strength at the minimum cost of operation. Tests have shown this time to be one full minute with *all materials in the drum.* An automatic timing device must be on every mixer, set so as to give the full time required. It is also essential that the batch used must not exceed the rated capacity of the drum, because a crowded drum will not give the proper mix within the time limit specified.

The consistency of concrete affects its strength and wearing qualities. The required amount of water, varying with the moisture content of the aggregates and the porosity of the stone, should be determined and rigidly adhered to by the operator. A uniform consistency giving the 1-in. slump specified can be easily worked. Occasional sloppy batches may be used but they should be thinly spread over the subgrade, and then covered with concrete of the proper consistency; extremely sloppy batches must be dumped outside the forms. Wet batches tend to cause uneven density and uneven shrinkage, which is sure to result in a wavy surface.

The concrete must be spread uniformly over the subgrade and finished with a machine that will insure density of the concrete and a smooth surface. Superelevated curves may be finished with the same crown in the templates of the machine as on tangents. Curve widening may be taken care of by using a double track on the inside of the curve and hand finishing the part thus formed. Concrete must be kept piled in front of the strikeboard, so that a uniform surface and density may be secured. Porous or low places caused by bunching of coarse aggregate or lack of fine materials must be filled with grout and worked into place with hand floats. After this the finishing machine must pass over it again to remove bumps that may have developed. Ordinarily, the finishing machine must pass over the surface not less than two times, with such other trips as may be required if extra material is added. Worn out machines and belts must not be allowed on the job for they can easily spoil a good surface or prevent the operator from getting the desired results.

The use of the longitudinal float is permitted if properly used. It should be not less than 10 ft. long with its operations lapping half way to secure a true surface.

The longitudinal center strip must be held rigidly in place, so as to produce a straight line. If a cap is used the strip should be 1 in. below the surface, but without a cap the strip must come within ½ in. of the surface to facilitate the edging of the center joint. The center joint is placed during construction to avoid irregular longitudinal cracks caused by the curling of the slab due to temperature changes. The outer edges of the slab and the edges of all joints must be rounded with a suitable edging tool.

Whenever the mixer shuts down for 30 minutes or more, a header board must be placed forming a regular tongue and groove construction joint. This joint must be vertical and the concrete on each side should be carefully spaded to insure density. Expansion joints to take care of temperature changes will not be placed unless special orders are issued to apply to work done after October 1. Joints are a source of weakness as they tend to localize the place of wear and expansion and contraction effects.

From the standpoint of the traveling public the riding qualities of the surface are most important. A smooth surface should be the constant aim of the engineer and contractor. To accomplish this, the straight edge must be used constantly and all variations of more than ¼ in. corrected before final belting. On the following morning the surface should again be tested and all bumps removed while the concrete is green. Excessive bumps, extending into the coarse aggregate, will have to be allowed to harden to be removed by carborundum stone or bush hammers at a later date. Such bumps tend to indicate slip-shod inspection. All construction joints should be given special attention to secure a true surface. Investigations have proved conclusively that it is the impact that destroys pavements and not the dead weight of vehicles. This impact is caused chiefly by uneven surfaces, the allowable limit of which is ¼ in. variation in 10 ft.

The quality of the concrete road and its surface depends upon its curing. Concrete properly cured has about twice the strength and resistance to wear of concrete left to cure in the open air.

As soon as possible, after the final belting and when the concrete has taken its initial set, the pavement must be covered with wet burlap and kept moist. This prevents too rapid drying of the surface and tends to avoid hair-checking.

Concrete may be cured by different methods, as follows: Earth or straw covering kept moist, ponding, or calcium chloride. The latter method is to be preferred between May 15 and October 1 due to the trouble usually experienced in keeping the surface properly covered and moist when other methods are used. Earth or straw covering kept moist are to be preferred during the dry cool days of spring and fall. The sides of the slab must be banked with earth as soon as the forms are removed. Test cylinders made at regular intervals during the pouring of the concrete must be cured under the same conditions as the slab, and sent in to the laboratory for crushing test at the age of 28 days. If calcium chloride is used for curing it must be evenly distributed with a squeegee to prevent surface injury. Traffic must be kept off the slab during the entire curing period.

Concreting During Cold Weather

Under ordinary conditions concrete pavements are not constructed when there is a probability of the temperature being less than 35 deg. F. Concrete poured during cold weather must be protected from frost and freezing for at least five days. Due to the fact that pavements laid during cold weather are at their maximum contraction, the use of expansion joints may be desirable. Their usefulness is questionable, however, and they must not be installed without special orders.

Shoulders

Shouldering is comparatively simple if the roadbed has been properly graded. The subgrade material is simply bladed out smooth from the edge of the slab to the full width of the roadbed and the shoulder line cut clean. Built up shoulders after the slab is laid cause settlement because they can not be compacted satisfactorily. If the subgrade has not been rolled at least 18 ins. outside the edges of the slab, the loose shoulder material should be as thoroughly compacted as is possible by rolling with a heavy truck, keeping one set of wheels on the slab. Shoulders should be built level with the edge of the pavement and be free from waves and irregularities; shrinkage will give the slope needed for drainage. Whenever deemed necessary stock-piles of stone or gravel should be left at convenient points so that ruts or washes which develop on grades along the edge of pavements may be filled. Shoulders and slopes that have a tendency to wash

should be sodded. On grades in excess of 4 per cent side ditches should be protected from wash by the use of paved gutters or retards.

Inspection and Workmanship

The quality of the product secured depends upon the ability and care of the contractors and field engineers. The engineering cost on projects is the insurance to the state that the work is properly done. Careful workmanship costs no more in the end than slip-shod work and insures riding qualities that satisfies the traveling public.

Quality in workmanship is secured by the co-operation of contractors and engineers to the mutual satisfaction of the builders and users of the highway throughout its life.

CONTROLLING THE SUBDIVISION OF LAND INTO BUILDING LOTS

By Robert Whitten, City Planning Consultant, 175 Fifth Ave., New York, N. Y.

In America the character of city growtr and expansion is in the main directed by the real estate subdivider. The work of subdividing land into building lots is performed in all the large cities by a numerous and important group of the real estate profession. Though often men of more than ordinary insight and civic spirit they are usually compelled by the rules of the game and the force of circumstances to devote their energies to the wholesale production and retail marketing of building lots, with little or no consideration of the things essential to the permanent welfare and attractiveness of the community, whose foundations they are laying.

The Lot Buyer

A large measure of responsibility for this condition may of course be charged to the ignorance of the lot buyers of the essentials that contribute to the making of a desirable residence neighborhood. An even larger measure of responsibility is often due to the very widespread desire to share in the supposed large increment in value accruing to the owner of urban land. Where such speculation is rife, distant fields are staked off with no consideration other than that of dividing the entire plat into a maximum number of minimum size lots. The lots are quickly sold by the well-known "free excursion," "free lot" and public auction methods.

There are in every city examples of a better type of subdivision for the more discriminating home owners of more than average means. These subdivisions are carefully laid out and restricted. Their measure of excellence and permanency is often limited by the smallness of the area over which it is possible to obtain a somewhat uniform standard of convenience and amenity. There are only a few examples throughout the country of large residence developments that show the real possibilities of applying the principles of city planning to the subdivision of land for residence purposes.

A Kansas City Subdivision

An outstanding illustration of this is the Country Club District of Kansas City, developed through the vision and civic statesmanship of J. C. Nichols, realtor. But the Country Club District and smaller well-known developments in a number of cities are adapted to the requirements of home owners of much more than average means. In all cities the subdivision of land into building lots to meet the wants of the great mass of home owners and tenants is substantially without any real planning for neighborhood convenience, welfare and amenity.

It is true that many states have authorized some slight control over land subdivisions by requiring the approval of a plat by the city council, city engineer or planning board as a condition precedent to its being received for public record. Such control has been intended to apply primarily to securing streets of some minimum width and of preventing jogs and dead end streets. It has not been based on a recognition of the need for a thoroughgoing control of land subdivision with a view to conserving in a broad way the health, convenience and amenity of the neighborhood.

Good Environment

The purpose of public control of the subdivision of land should be that of securing an appropriate street and block layout with relation to good city planning and zoning principles. It involves the creation of a good neighborhood environment and its correlation with the planning and zoning of the entire region. Some of the characteristics or essentials of a good neighborhood environment are as follows:

1. The neighborhood must have all the functions and facilities of a complete

residence unit. It must have churches, schools, shops, assembly halls, clubs and small parks or commons.

2. It must have a well ordered arrangement of these various functions and facilities and a local system of circulation that will not interfere with or be incommoded by the general circulation system of the city or of the region as a whole.

3. The local streets, small parks, building lots and buildings should in the main conform to the topography. They should be fitted to the contour of the land and their location and arrangement should seem to be necessary and natural.

4. The residence neighborhood must possess the natural beauty that comes from private gardens, street trees and small parks; and from the careful preservation in its planning of the scenic beauty and exceptional physical features of its site.

A good neighborhood environment involves opportunities for contact with nature. It involves intimate contact with gardens, trees, natural landscape features, and extended water and sky views. It involves opportunities for walks in quiet places. It involves ample play space for the children both in private gardens about the homes and in a "commons" serving an entire block or subdivision.

Conserving Natural Beauty

One of the prime purposes of platting control should be the conservation of natural beauty to the fullest extent consistent with use for residence purposes. A clump of trees, a wooded ravine, a rocky ledge, a water view—is a community asset of very real value. It should be conserved for the community either on private property through an appropriate public easement or as a small park or commons.

Daily contact with nature in some of its varied forms is an essential of healthy, normal living. It has an undoubted energizing, tonic effect that is no less real because incapable of actual measurement. It has a restful effect on eye and nerve and aids clarity of thought. It facilitates a sane, joyous outlook on life. It stimulates and it inspires. Every human being finds natural beauty pleasant and agreeable. Men differ in their tastes as to dress, as to architecture and as to all forms of art; but there is no real disagreement as to natural objects. Beauty of form and color in growing things is innate; and its universal and instinctive recognition by humans is due to the fact it is good and has a real function and purpose in the life and work of the world.

Shade Trees

"The comfort to be derived from shade trees has long been recognized. The early settlers of this country saved fine trees about their homes, on the village greens, along the country roads, and in the fields. Later, as villages grew, the householders planted trees adjoining their properties, and the result has been the beautiful elm-shaded villages of New England, the maple-shaded towns of New York and the Ohio Valley, and the oak shaded streets of the Southeastern states."—F. L. Mulford, "Street Trees," U. S. Department of Agriculture, Bulletin 816.

A residence neighborhood with large gardens and numerous trees is undoubtedly cooler and more comfortable and probably more healthful in the hot summer months than a similar neighborhood where almost the entire area of the earth is covered with pavements and buildings. Brick and stone absorb heat during the day and radiate heat during the night. Trees protect the earth from the heat of the sun during the day and evaporation from the leaves lowers the temperatures at night.

"The shade of trees protects the earth from the direct rays of the sun, and prevents solar radiation from the earth. This effect is of immense importance in cities where the paved streets become excessively heated, and radiation creates one of the most dangerous sources of heat. Whoever has walked in the streets of New York, on a hot summer's day. protected from the direct rays of a midday sun by his umbrella, has found the reflected heat of the pavement intolerable. If, for a moment, he passed into the dense shade of a tree, he at once experienced a marked sense of relief. This relief is not due so much to the shade as to the cooling effect of the vaporization from the leaves of the tree." —Stephen Smith, Vegetation a remedy for the summer heat of cities, Appleton's "Popular Science Monthly," February, 1899.

Regulation of Subdivision

The reasons that make the regulation of the use of private property necessary and legal in zoning apply equally to platting or the subdivision of land into

building lots. Zoning is the method devised to regulate the use of property in the common interest and as such is concerned primarily with the orderly and harmonious development of the community. It is primarily a matter of relationship between the various uses and intensities of use of property. It concerns itself not so much with what takes place in a particular building or with the effects of a particular use or mode of construction on the occupants of such building, as it does with the effects of a particular use or mode of construction upon the appropriate use of adjacent property, upon the orderly development of the neighborhood as a whole and upon the general welfare of the entire community. It aims to enforce fair play in the development and use of property by requiring all owners to contribute to the yards and open space of the neighborhood and thus prevents any owner from unduly cutting off or monopolizing the community's common stock of light and air.

The subdivision of land into building lots for purposes of buildings or sale is a use of land that has not heretofore been included within the scope of zoning, nor has it been considered as subject to direct control under the police powers of the state. Yet such subdivision affects the health, safety and welfare of the community as fundamentally as any feature of zoning. Heretofore little control over the subdivision of land has been attempted except through the requirement that the plat of a proposed subdivision receive official approval as a condition precedent to its being received for record. No attempt has usually been made to prevent subdivision and sale by metes and bounds without reference to a recorded plat, or to prevent the erection of houses on lots within an unapproved subdivision. Direct control of the subdivision of land into building lots has not been insisted upon as a reasonable and necessary regulation of the use of property in the interest of health, safety and the general welfare. But in the states where the zoning principle is accepted and established, it is inconceivable that the application of this principle to the most important and fundamental single use of property that there is, that of its subdivision into building lots, should be long delayed.

Plan for Unbuilt Areas

Planning and zoning will progress more rapidly and more efficiently when it is recognized that there should be a somewhat different procedure and method of planning and zoning control in the unbuilt areas. The character and method of planning control and zoning appropriate for a built-up urban community is not that which is appropriate for an area that can be planned and zoned in advance of urban development. This results primarily from the fact that a much greater measure of control is reasonable and practicable in dealing with the unbuilt areas.

Both for efficiency in planning and efficiency in zoning it is necessary that a comprehensive plan for the unbuilt areas be prepared several years in advance of actual development. This general or master plan should then be worked out in detail and applied as each tract of land is subdivided into building lots.

This master plan would combine zoning, park and thorofare planning. Subject to this master plan details could be adjusted in the approval of the subdivision plat.

When the unbuilt areas to be controlled are within the limits of a city or town a simple extension of zoning powers to include control of the subdivision of land into building lots and the regulation of the erection of buildings in unapproved subdivisions or within the lines of proposed streets will be sufficient to make it possible to secure a fairly comprehensive and adequate control of development in the unbuilt areas.

Master Plan and Ordinance

With such powers a plan board, after making a regional survey, could prepare for adoption by the council a master plan and ordinance that would include, and subject to special regulation, all the generally unbuilt and unsubdivided area within the municipality. Such master plan and ordinance would as to the unbuilt areas:

a. Determine the general location and width of all main thorofares and parkways.

b. Determine the larger industrial and business zones.

c. Determine the areas most suitable for large parks and water supply and forest reservations.

d. Determine the residential zones.

e. Divide the entire area into housing density zones.

f. Define the measure of control to be exercised in connection with the approval of plats of subdivisions.

Subject to this master plan and ordinance, some of the matters that should be determined or adjusted in connection with the subdivision of land into building lots are the following:

1. The general plan of main thorofares should be substantially maintained. Local and secondary streets should be controlled as to location, width, grade and improvement. Rear easements for public utility services should in general be required.

2. Building lines should be established.

3. Small neighborhood parks and playgrounds should be required.

4. Lot shapes and areas should be controlled.

5. General density and area regulations should be adjusted so as to provide in appropriate cases for group houses or apartment houses and so as to permit of appropriate variety in housing types and methods.

6. Locations for small store centers should be determined and rear alleys should be required in connection therewith. Loading space for trucks and parking space for automobiles should also be required in connection with business centers.

7. In all the above, considerations of neighborhood amenity and comfort should have a chief place. Natural beauty should be preserved in the location of streets, in the fixing of building lines and in the location of parks and playgrounds.

The control above outlined if exercised wisely and reasonably would inure to the advantage of all concerned. To insure moderation and fairness the subdivider should have the right to have any harsh or arbitrary requirement of the plan board reviewed by the court on a writ of certiorari. Reasonable requirements as to lot sizes, small parks and street space will not result in loss to the subdivider provided all like areas similarly situated are subjected to substantially the same requirements. The subdivider must know the general nature of the requirements to which a tract will be subjected in order to determine what he can afford to pay for the tract. This amount per acre that the subdivider can afford to pay fixes the market value of the raw land when ripe for subdivision.

Nor will reasonable and carefully applied platting regulations result in higher costs to the home owner or in higher rents to the tenant. They should give the great mass of home owners and tenants a more comfortable, wholesome and attractive environment without increased cost. Savings will be effected in development costs for grading and pavements that will probably offset any increased cost for utilities due to greater average lot widths. A general requirement for greater area in common open spaces should be discounted in the acreage value of the raw land and should not result in increased cost of building lots.

The value of land for residence purposes depends of course on supply and demand. If there are only a very limited number of desirable and attractive residence neighborhoods the lots there located will bring a premium. If through subdivision control similar standards of comfort and amenity are applied generally there will be no corresponding increase in the price of lots. This is fortunate for we must find ways of reducing housing costs for the two thirds of the total number of families having the lower incomes, if we would greatly improve housing conditions for the mass of the population.

There are big economic problems connected with urban expansion and the control of subdivisions that need more thorough study. Our scattered suburban growth greatly increases the cost of utilities and of municipal service and administration. It is a question whether it would not be more economical for the city to pay out of its general funds the entire cost of street improvements within subdivisions needed for expansion, if thereby it could secure a building up of the areas immediately adjacent to existing built-up area rather than a scattering of houses over many square miles of area that will not be largely built up for years. Perhaps such assumption by the municipality of street improvement costs will prove to be the best way to afford practical and substantial relief in the housing of the lower income class, and at the same time will make effective a larger measure of public control of the subdivision of land than might otherwise prove feasible.

THE BUSINESS VALUE OF CITY AND REGIONAL PLANNING

By Bancroft Gherardi, Vice-President and Chief Engineer, American Telephone & Telegraph Company, 195 Broadway, New York, N. Y.

Like every other good citizen, I am

keenly desirous that our cities shall develop in such manner that they will in the highest degree be healthful, beautiful and comfortable places in which to live. That they will be effectively laid out to permit the free movement of traffic. That they will permit the efficient business operation of the community with resulting economic gain to all. That they will be cities in which the coming generations may grow up, be educated, and in due course take their places as healthy, prosperous and happy members of the community, the nation and the world. In a field of planning having, in some of its features at least, factors closely analogous to those concerned in community and regional planning, I have had experience for over 30 years.

It may be of interest at the start to refer briefly to one of the problems of community life requiring advance planning and with which I have been more directly concerned—namely, the communicating system. My life work has been telephone engineering and the related operating questions, and from the brief statement I am about to make I believe you will recognize that there are many points of similarity between planning for the telephone needs of a community and planning for the community as a whole. A reference to the communication problem may, therefore, develop points of interest in the broader planning to which you are giving intensive consideration.

In the earliest days of telephone service, the problem of laying out telephone plant was a simple one. A very small switchboard, simple in character and easily moved if necessary, was placed in some convenient location, usually in rented quarters, and from that switchboard wires were run one by one as needed to the premises of those desiring service, either on poles or over housetops. Under such simple and rudimentary conditions, no serious questions of the future needed to be answered. Today, how different is the telephone situation in New York or in any other large city! Large and specially designed buildings must be constructed for the accommodation of the necessary interconnecting or switching mechanisms; expensive switchboards must be placed in these buildings; conduits must be extended from each of these buildings along appropriate routes to reach the tens of thousands of telephones which will get service from these switchboards; other conduits must be placed between these switchboards and the other buildings and switchboards throughout the city so as to provide the means of intercommunication between the subscribers connected with the switchboards located in different buildings; still other conduits and cables must be placed between these switchboards and the central switchboard or toll board from which radiate cables and conduits and lines extending to the suburban area, to adjacent cities, and to all the other principal cities in the United States.

Each of the buildings must be placed in some definite location and must be planned for some definite ultimate size, although, of course, the whole building need not be built at one time. Ducts can not be placed under the streets one by one as needed. Public sentiment would, of course, not tolerate the opening of important street routes several times, or placing an additional duct. Neither would it be economical, if practicable, to construct conduits in this piecemeal way. The manholes in these conduits must be planned with reference to the number of ducts extending into them, not only the ducts initially placed, but if side runs are to be made from these manholes or if other ducts are to be placed later, this fact must be foreseen and provided for, or extensive and expensive alterations are inevitable at a later date. We know that this advance planning has saved the telephone companies, and hence their subscribers, large sums of money. Needless to say, I am impressed by the fact that adequate advance city or regional planning can not but result in the long run in magnificent savings to the community.

I might go on and multiply the conditions which must be met in constructing telephone plant for a large city, in which not only the population is growing and moving, but where the demand for telephone service is growing more rapidly than the population. Enough, however, has been said, I believe, to indicate clearly to you that the telephone company on every item of its buildings, conduits and cable construction must answer for itself certain questions as to the future development of the community. This is not only true of the communication problem, but also of other public utilities, although in many respects the telephone problem may be more closely analogous to that of city or regional planning. Whether the city

has a comprehensive plan or not, it must answer these questions relative to the future. Each time it lays out a street, for example, it gives a definite answer as to its expectation of the future requirements along that route. How much better it will be, therefore, if these various steps are taken in line with some well-thought-out plan of procedure!

Underlying all of this future planning is the question of what will be the total population of the community, the region and the state, twenty-five or fifty years hence. What will be the distribution of this population over not only the area of the community at the time the plan is made but over the outlying areas into which the community will necessarily extend? What will be the nature of the population and of its activities twenty-five or fifty years ahead? As a result of these considerations, what will be the extent of the community of interest between the different sections of the community, and between the community as a whole, the surrounding communities, and the more distant communities within the country and without?

The forces and factors which we are dealing with in future planning are forces and factors beyond our control. Nevertheless, it is necessary for us in our planning to undertake to determine them as best we may and to measure their effects upon the numbers of the population, its changing character and its changing interests, and to plan and provide adequately to meet the estimated developments and their requirements. To the extent that zoning may be effectively developed and applied to anticipate and express the operation of the natural forces and factors at work, it will tend to diminish the uncertainty of some of these factors.

That we have had in a nation-wide industry a considerable measure of success in our efforts to look into the future development of communities will, I believe, be a note of encouragement to all who are interested in city or regional planning, because the underlying questions which we try to answer for ourselves and which our experience shows we are able to answer with a sufficient degree of accuracy to fully justify such planning are some of the questions which must lie at the root of community planning.

Such planning must concern itself with a future probable population, its distribution, character and interests. As we must provide adequate pathways for the circulation of telephone traffic within the city, the city plan must provide adequate circulation routes for traffic on foot, in vehicles on the streets, and in transportation systems of one kind or another. As we must provide buildings suitably located with reference to the wire center, the city must provide facilities, such as schools, centrally located with reference to the population which they too are to serve. As we must provide routes adequate in both number and capacity from the suburban areas and from distant points to accommodate the toll telephone traffic, highways and transportation systems to more distant points must be comprehended in the city plan. In addition, the city plan must cover many other factors, at least one of which—the matter of playgrounds, parks and other open spaces—is so important that it can not be omitted from specific mention.

In city planning, as in our plans, we must recognize that we are dealing with ultimate tendencies largely beyond control and the effects of which are not capable of exact valuation. Plans, therefore, must be flexible, capable of modification from time to time, and such modifications must be made as changing conditions show them to be advisable.

In another respect, it seems to me that our planning is similar to city planning. In our work, as in yours, a system is being planned, all of which is not being built at one time. We are both really planning a growing organism, and the layout or general plan is our expectation of the requirements many years ahead. In adopting a city and regional plan, it obviously does not require that the community be committed to its immediate completion, but rather, as the community develops, each step as taken is in line with the picture of the ultimate requirements of the community. Inconsistencies are avoided, and while the plan may not be perfect, it can not be doubted that it will be productive of far better results than no plan at all or a plan not based on a full and careful study of all underlying factors.

No one who is familiar with one of our large cities can, I believe, doubt the business value and desirability of city planning and the many advantages which will come to a community that intelligently approaches this question, and after full

study of all of the factors adopts and is guided by a well-thought-out plan. To some it may seem that the forces determining the growth of a community are so obscure and uncertain in their operation that practical planning is impossible. Our experience, however, convinces us that these forces and tendencies are not incapable of determination within limits and that, as we have found such studies of inestimable value to us in the proper planning of our business, the community planners and public authorities will find that their problems are capable of definite solution—not precise solution, because from the nature of the case the factors to be dealt with exclude precision—but they are capable of being determined, with a sufficient degree of precision, so that the results of such studies may be followed with far better results than will result from a haphazard and piecemeal method of planning without any comprehensive underlying basis.

The foregoing paper by Mr. Gherardi was read at the recent meeting of the International Town, City and Regional Planning Conference at New York.

NEW FORD UNIT FOR LIGHT TRUCKING

Announcement is made by the Ford Motor Company of a new light trucking unit. The equipment is a combination of the standard Ford Runabout with rear deck replaced by a pick-up body.

This will prove of unusual interest to contractors, retail tradesmen, dairymen, farmers and others who are faced with the problem of securing rapid transportation of light loads at low cost.

Now, there is an all-steel body available, securely attached to the frame of the chassis, with rear door adjustable chains, side flanges, and steel floor strips with sunken bolt heads. The inside dimensions of the body are 40¾ in. by 56 in. Height from floor to top of flare is 13 in.

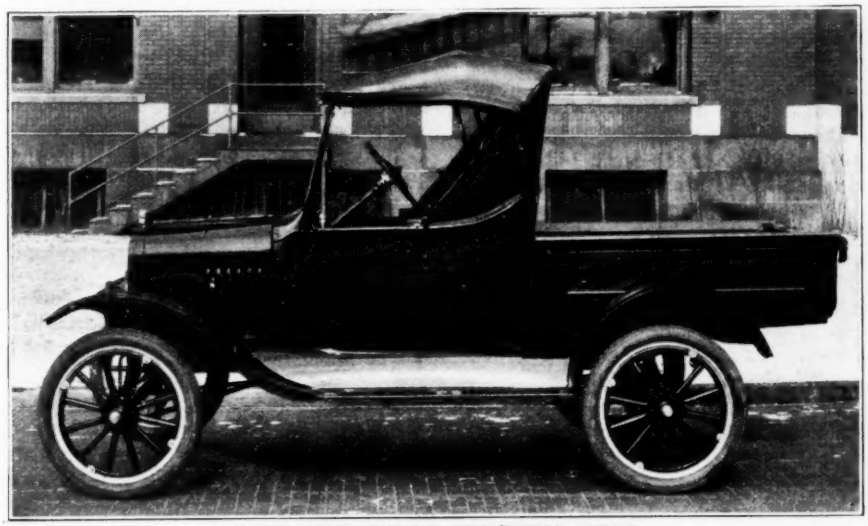
Orders are being taken now for immediate delivery at an announced price of $366 F. O. B. Detroit, including electric starter and demountable rims.

INDUSTRIAL DEMOCRACY IN A PIPE FOUNDRY

By Paul A. Ivy, Vice-President, Secretary and General Sales Manager, American Cast Iron Pipe Company, Birmingham, Alabama

(Editor's Note: The following address by Mr. Ivy was delivered at the convention of the Southeastern Water and Light Association, May 19, 1925.)

It will be exceedingly unfortunate if the remarks I am about to make to you on the subject of "Industrial Democracy in a Pipe Foundry" are misinterpreted or misconstrued in any way. I, of course, am not unaware of the handicap I am under because I happen to be the General Sales Manager of a large manufac-



NEW FORD LIGHT TRUCKING UNIT

turing concern whose products many or all of you use to a considerable extent. I want to say to you, however, that I am not here today as a salesman or a sales manager of material things. The company I represent is trying to manufacture two major products—men and pipe. The one I propose to talk to you about is men.

No matter what our relative position or condition may be, whether we are producers or consumers, rich or poor, literate or illiterate, all of us primarily are interested in the members of the human race (including ourselves) more than any other one thing in existence. Most of us who have reached the middle stand of life have fully realized that, after all, the material things of life are incidental. It is the spiritual values of life that are fundamental and upon which human happiness, peace and welfare rest. The heritage of the human race is spiritual progress—its ultimate goal, happiness. You and I have in common these fundamental characteristics. We may spend a large part of our life in wrestling with business affairs—some of us making and selling pipe, others buying and laying this pipe, selling water and current, and still others tilling a farm, operating a grocery store, or engaged in some other occupation. But underneath all of this exterior activity lies our fundamental interest in humanity—the welfare of the race. And it is for this reason, undoubtedly, that the officials of your Association have asked me to describe to you at this time some of the phases of an experiment in industrial government now in operation at the plants of the American Cast Iron Pipe Company.

The plant and business of this company are owned entirely by the employes, although each employe's title to his share of ownership is by sole virtue of his employment with the company. If he ceases to be an employe, he ceases to be an owner and if an outside man becomes an employe, by reason of that fact alone he at the same time becomes a part owner. In other words, the company is more or less of a public institution, managed in much the same way as the government of a municipality or the government of the state. This condition of affairs was brought about by a man named John J. Eagan, who until his death a year ago was a prominent capitalist and social worker of Atlanta, Ga. Mr. Eagan was the money power behind the company ever since its organization and at different stages of its career was either president or chairman of the board of directors. Years ago Mr. Eagan conceived the idea of a democratic form of government in industry. By nature, he was very conservative, however, and he proceeded slowly in working out his convictions that the worker in industry was entitled to a larger share of the proceeds of industry. Little did the employes of Acipco realize how they were being watched during the past ten or twelve years as step by step Mr. Eagan slowly developed his plans. He believed from the first that his ideas were right and the employes of Acipco would prove it. But he knew that such marvelous changes could not be brought about over night, that a great amount of training and accumulated experience was necessary before the worker of industry would be able to take an intelligent part in directing the business. Mr. Eagan started out, therefore, with such comparatively unimportant things as construction of a bath house, which at the time, however, was a very novel innovation in a cast-iron pipe foundry.

Then followed the medical dispensary, the safety first department, the Acipco Mutual Benefit Association, the pension fund, the employes' preferred stock plan and, finally, three years ago, when he believed that the employes were ready and prepared to share greater responsibility, he inaugurated employes' representation in the company's affairs by means of a board of operatives. By this time he had fully made up his mind that ultimately he would give to the employes of Acipco the plant and the business. It was his intention, however, that the workers should thoroughly prove themselves worthy and capable of this responsibility before such a radical change was made. In the meantime, he kept gradually changing the organization from a form of autocracy to a form of democracy—substituting for centralized authority a committee system of control, developing his employes' representation plan so that any member of the organization through the proper channels could bring his ideas and judgment to bear on the affairs of the company.

This was the state of affairs, when in the fall of 1923 Mr. Eagan was suddenly taken ill, dying the following spring on March 30, 1924. Before his death, however, Mr. Eagan had foreseen the end and prepared for it by providing in his will

what he had expected to do a year or two later had he lived. He wrote a codicil to his will bequeathing the plant and the business of the American Cast Iron Pipe Company to its employes and as a means for them to function as the owners of the plant, he provided for a Board of Trustees, composed jointly of the Board of Operatives, elected by the men, and the Board of Management, elected by the Directors. The Board of Trustees, as stockholders, elects annually a Board of Directors and this Board of Directors elects annually the officers of the company and a Board of Management to conduct the business.

This plan of industrial government is based on the belief that the teachings of Jesus are applicable to business. Such teachings applied to business, Mr. Eagan believed to mean:

A reasonable living wage to the lowest-paid workman.

Regular employment to every member of the organization.

An actual application of the Golden Rule to relations between the company as producer and the public as consumer.

The plan is further based on Mr. Eagan's belief that industry functions logically and best when it is recognized that four groups are fundamentally interested in it, namely:

1. Employes (producers).
2. Managers (producers).
3. Owners (stockholders).
4. Public (consumers).

By the terms of Mr. Eagan's will, at Acipco the employes and the managers, Groups 1 and 2, are also the stockholders and owners, Group 3. However, although they may be the same persons, the function of these groups are separate and distinct from each other and the operation of the plan is, therefore, easy to explain if these four groups are considered in their separate capacities and irrespective of their interlocking personnel.

The third phase of the basis of this plan rests on the following three principles:

1. The four groups as named should share responsibility for failure or success in the operation of the business.

2. Therefore, these four groups should share knowledge of the company's affairs.

3. Finally, these four groups should share profits or losses.

In working out these principles, the employes elect the Board of Operatives and the Board of Operatives elects two members to serve on the company's Board of Directors. As soon as proper arrangements can be made, one or two representatives of the public will be added also to the company's Board of Directors.

Thus responsibility for success of the business is distributed over all parties concerned and knowledge of the company's affairs is likewise brought to all parties concerned.

The third principle is carried out by means of sharing the profits of the business annually with the employes and selling the products of the company to the public at actual cost plus a reasonable profit. In other words, this company is forbidden to take advantage of a favorable market to make high profits, and similar practices, which are more or less common in business and have been so for many years.

It would take too much time to go into the many details of the practical working of this plan. In addition to the activities mentioned, however, you might be interested to learn that there is a pension fund established to care for employes during old age and that after about nine years this fund at the present time has accumulated approximately $350,000. The Mutual Benefit Association pays out to employes an average of about $2,000 per month as sick and accident benefits. Preferred stock of the company is sold to employes on a plan by which it is made to pay them an annual return of approximately 10 per cent on the money they invest and up to Dec. 31, 1924, the employes had bought and paid for approximately $160,000 worth of this stock.

The company operates a cooperative store where all kinds of groceries, meats, dry goods, shoes, etc., are sold at cost.

An industrial Y. M. C. A. is operated by the company with two employed secretaries, there is a plant library, a system of apprenticeship training, a school for foremen, a savings deposit system, a plant newspaper, a suggestion box system, a plan for financing homes for both white and colored employes and many similar activities.

Last but not least is the medical service department where medical or surgi-

cal treatment is given to employes without cost during illness or injury. This is by no means the old system of a company doctor. The service is given to the immediate members of an employe's family and the department is housed in a handsome new brick building which cost $150,000, employing a staff of physicians, surgeons, dentists and trained nurses and equipped with the latest instruments developed by surgical and medical science.

But I must refrain from going into these details and leave the subject with you only in its high lights. Mr. Eagan believed that every man who was willing to work was entitled to a decent, healthful living, or what is commonly called a minimum wage. He set machinery in motion to find out what this minimum wage should be at Acipco and he contributed the personal earnings from his stock in the company to be used in increasing the income of those employes whose wages did not reach such a minimum. This was before the present profit-sharing plan, by reason of which it is now considered every employe is receiving the minimum wage.

Mr. Eagan believed that the revenue produced by industry should be more equally distributed between the worker, the manager, and the stockholder. It was on these grounds that he instituted the plan of profit sharing. Finally Mr. Eagan believed that the job of making and selling pipe constituted a wonderful opportunity to serve humanity. He had the vision of pipe makers furnishing the means for giving pure, clean, wholesome water or efficient gas to the men, women and children of some distant city. In this way, he believed that we were not making pipe, but that we were serving our fellow men in all sections of the country and that our labor by means of our pipe would continue to do this for many years after we are dead. For this reason, he believed that it was our duty to sell our product to the public at the lowest possible price which would permit us to make a fair profit for ourselves.

Mr. Eagan many believed was a prophet in the wilderness. Into the present-day period of conflict between labor and capital, between producer and consumer, he brought his conception of the spirit of the lowly Jesus. Many of his convictions are today regarded by leading men as radical, or visionary, and still others believe the day will come when he will be looked upon as a man who lived and died amid events of world importance and whose finger pointed the way to struggling humanity when the sky was dark and there was confusion.

QUANTITIES OF MATERIALS FOR CONCRETE

(Editor's Note: Following is a brief abstract of the second edition of Bulletin No. 9, on Quantities of Materials for Concrete, by Duff A. Abrams and Stanton Walker, of Structural Materials Research Laboratory, of Lewis Institute.)

The principal subject-matter of the bulletin is a series of tables of proportions and quantities for Portland cement concrete for compressive strengths of 2,000, 2,500, 3,000, 3,500 and 4,000 lbs. per sq. in. at 28 days, using fine and coarse aggregates of different sizes, and concrete of a wide range of workability as measured by the slump test.

The tables are based on the water-ratio method of proportioning concrete developed in this laboratory as a result of many thousands of tests. They differ principally from tables by other authors in that the proportions have been selected with definite strengths in view, and take into account the quantity of mixing water as well as the size and grading of the fine and coarse aggregates.

This bulletin was first published in 1921, but had been out of print for several months. In the second edition, the text has been rewritten to constitute a more complete discussion of the subject. A method of taking into account the differences in volumes of materials when measured in the laboratory and when measured under field conditions is described. The descriptions of field and laboratory test methods have been enlarged and include recent changes in the standards of the American Society for Testing Materials.

TEST OF TRAFFIC PAINT

An interesting test of Du Pont traffic white paint was recently made at Knoxville, Tennessee. Four inch lines were laid down at an average rate of 200 lin. ft. per minute, paint consumption at the rate of 7.6 gals. per mile. The material was applied as a first coat to a new concrete surface. At a temperature of 48 degs. F., the paint was track-proof in 27 minutes. In putting down the material it was found that it required no change of pressure or feed in the machine.

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Tarvia Service *Chapter VI*

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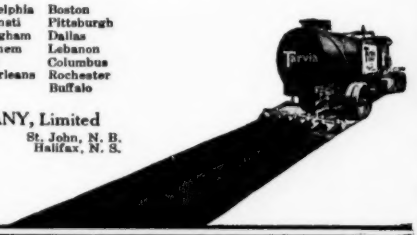
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